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VOL. CXXXIII.—No. 3456] LONDON: FRIDAY EVENING, MARCH 24, 1922 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY ISLAND POST 1s. 3d.

PUBLIC NOTICES

TEMPORARY CIVIL ENGINEERS FOR SERVICE IN BURMA.

The Secretary of State for India is prepared to receive APPLICATIONS for TEN APPOINTMENTS as TEMPORARY CIVIL ENGINEER for service under the Government of Burma, on agreements for three or five years, on pay of Rs. 700 a month for the first year, rising by annual increments of Rs. 100 a month to Rs. 1000 a month for the fourth and fifth years. No extension of service beyond the term of the original agreement is contemplated.

Candidates must be British subjects of not less than 20 and not more than 35 years of age, and of good character and sound physique. They must either (1) have obtained a recognised university degree or other distinction in Civil Engineering, or (2) have obtained the Associate Membership of the Institution of Civil Engineers, or (3) produce evidence that they are otherwise eligible under the regulations. They must, in addition, have had not less than two years' practical experience on works, preferably as Assistants to Borough or Municipal Engineers in this country.

Applications from candidates must reach the India Office not later than 1st May. Printed forms, together with information regarding the conditions of appointment, may now be obtained from the SECRETARY, Public Works Department, India Office, Whitehall, London, S.W. 1.

India Office,
17th March, 1922. 7749

No. 00134 of 1922
IN THE HIGH COURT OF JUSTICE
CHANCERY DIVISION
MR. JUSTICE P. O. LAWRENCE
IN THE MATTER of W. H. DORMAN & COMPANY LIMITED and Reduced
and
IN THE MATTER of the COMPANIES (CONSOLIDATION) ACT 1908

Notice is Hereby Given that a Petition was on the 7th day of March 1922 presented to His Majesty's High Court of Justice for the confirmation of the reduction of the capital of the above-named Company from £700,000 to £437,500 And notice is hereby further given that the said Petition is directed to be heard before His Lordship Mr. Justice P. O. Lawrence on Tuesday the 4th day of April 1922 Any creditor or shareholder of the said Company desiring to oppose the making of an order for the confirmation of the said reduction of capital should appear at the time of hearing in person or by Counsel for that purpose. A copy of the said petition will be furnished to any such person requiring the same by the undersigned on payment of the regulated charge for the same

DATED the 21st day of March 1922
CAPORN and CAMPBELL,
84, Bride's House, Salisbury-square,
London, E.C. 4.
7743 Solicitors for the above-named Company.

British Standardised Steel SAMPLES

Issued jointly by
THE IRON AND STEEL INSTITUTE
AND THE
NATIONAL PHYSICAL LABORATORY

These samples are now available, together with certificate of standardisation, at the price of 21s. per bottle, containing 50 grammes. They may be obtained post free by sending order with remittance, direct from

THE NATIONAL PHYSICAL LABORATORY
(Metallurgy Dept., Teddington, Middlesex);
or by post or personal application from
The Secretary, NORTH MIDLANDS DISTRICT AUTHORITY, Dept. of Applied Science, The University, Sheffield.

Depots in other centres are being arranged.

The Standards at present available are:—
No. 5 Carbon (C = 0.45 per cent.) Acid O.H. Steel.
No. 6 Carbon (C = 0.10 per cent.) Basic O.H. Steel.
No. 1 Sulphur (S = 0.037 per cent.).
No. 2 Sulphur (S = 0.071 per cent.).
Others are in preparation and will be issued when ready. 7048

Institution of Municipal and COUNTY ENGINEERS.

TRIALS, DEMONSTRATIONS AND KINEMATOGRAPH EXHIBITION OF PLANT AND PROCESSES OF INTEREST TO MUNICIPAL AND COUNTY ENGINEERS.

ANNUAL MEETING AND CONFERENCE, CARDIFF, JUNE 21, 22, 23, 24, 1922.

The Institution is undertaking a series of trials and demonstrations with the object of enabling members of the Institution and representatives of Local Authorities accompanying them to see the apparatus in operation under normal working conditions, to give manufacturers the opportunity of showing what their plant will perform under such conditions, and to gain useful knowledge of the duty required and of the comparative efficiency of various similar appliances now on the market.

The following are the proposed classes for the "Trials":"
1. Self-propelled Road Sweeping Apparatus.
2. Combined Road Sweeping and Loading Apparatus.
3. Road Tarring Apparatus.
4. Road Gritting Apparatus.
5. Mechanical Loading Apparatus.
6. Concrete Mixers.
7. Electrical Vehicles.
8. Combination of any of the foregoing Apparatus.

Other plant and processes may be entered for the "Demonstrations" and Kinematograph Exhibition.

Regulations and forms of entry may be obtained from the SECRETARY, Institution of Municipal and County Engineers, 92, Victoria-street, London, S.W. 1. 7757

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.

(Registered under the Trade Union Act.)
An Association specially formed to look after the interests of Foremen in their Supervisory Capacity.
All communications to Head Offices,
E. W. REID, 96, Belgrave-road,
General Secretary. Victoria, S.W. 1.
2x.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

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(With a Two-Page Supplement.)

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Die Castings.

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PUBLIC NOTICES

Alsager Waterworks.
TO BORING CONTRACTORS.

The Alsager Urban District Council invite TENDERS for DEEPENING an existing BORE-HOLE in the New Red Sandstone from 290ft. to 490ft., 10in. in diameter.

The existing bore-hole is inside the engine-house adjacent to another bore-hole and to the existing pump foundations.

The machinery in the adjacent bore-hole will be regularly worked to maintain the supply to the district.

Copies of the specification, &c., may be obtained from Messrs. G. and F. W. Hodson, M.I.C.E., Consulting Engineers, Loughborough, on receipt of cheque for £2 2s. (which will be returned on receipt of a bona fide Tender), and the site may be inspected on application to H. V. Lynam, Esq., Surveyor to the Council, Alsager, Cheshire.

Tenders, on the form supplied, to be received by the undersigned on or before April 24th, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

Dated this 20th day of March, 1922.
JOHN J. NELSON,
Clerk to the Council.
Alsager, Stoke-on-Trent. 7734

Borough of Portsmouth.
MAIN DRAINAGE.
CONTRACT No. 5.
TO CONTRACTORS.

The Corporation of Portsmouth is prepared to receive TENDERS for the CONSTRUCTION of BRICK CULVERTS, DETRITUS and SCREEN CHAMBERS, SUCTION CULVERT, PUMP FOUNDATIONS and BUILDINGS, and other WORKS at their Sewage Pumping Station at Eastney, in accordance with drawings, general conditions and specification prepared by the Engineer, Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, 26, Victoria-street, Westminster, S.W. 1.

The specification, bill of quantities and form of Tender may be obtained from and the drawings seen at the office of the Engineer upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Main Drainage, Contract No. 5," addressed to the Town Clerk, are to be delivered at his office at or before 9 a.m. on Friday, 21st April, 1922.

The Corporation does not bind itself to accept the lowest or any Tender.

F. J. SPARKS,
Town Clerk.
Town Clerk's Office,
The Town Hall, Portsmouth,
17th March, 1922. 7735

City of Chichester.
WATER DEPARTMENT.
PUMPING MACHINERY.

The Town Council of the City of Chichester invite TENDERS for the SUPPLY and ERECTION of suitable TRIPLE-RAM PUMPS at their Waterworks Pumping Station, for pumping 40,000 gallons per hour against a static head of 130ft., but later on the duty will be increased.

Tenders are invited for Pumping Units driven by Suction Gas Engines and also alternatively by Heavy Oil Engines or Electric Motors.

General conditions, specification, and form of Tender may be obtained from the City Engineer, Mr. Frank J. Lobley, A.M.I.C.E., at his office during the usual office hours, upon payment of a deposit of Four Guineas, which will be returned on receipt of a bona fide Tender and the return of any documents supplied.

Tenders, in sealed envelopes, endorsed "Waterworks Contract No. 2," &c., are to be received not later than the first post on Wednesday, the 5th day of April, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

J. W. LOADER COOPER,
Town Clerk.
East-street, Chichester,
29th March, 1922. 7741

PUBLIC NOTICES

City of Leicester.
WATER DEPARTMENT.
PUMPING MACHINERY.

The Water Committee of the City of Leicester invite TENDERS for the SUPPLY and ERECTION of OIL or GAS ENGINES and PUMPS for pumping continuously 50,000 gallons of water per hour through about 70,000ft. of 14in. diameter pipes against a static head of 122ft.

General conditions, specification, and form of Tender may be obtained from G. T. Edwards, Esq., M. Inst. C.E., Water Engineer and Manager, Bowling Green-street, Leicester, on deposit of a cheque value Five Pounds, which will be returned on receipt of a bona fide Tender and the return of all documents supplied.

Tenders, endorsed "Pumping Machinery," are to be delivered to the undersigned in a sealed envelope on or before 10 a.m. on April 10th next.

The Committee do not bind themselves to accept the lowest or any Tender.

G. T. EDWARDS, M. Inst. C.E.,
Engineer and Manager.
Waterworks Office,
Bowling Green-street, Leicester. 7685

County Borough of Birkenhead.
WATER COMMITTEE.
FOR SALE.

The Corporation are prepared to receive OFFERS for the following PUMPING PLANT, which is for disposal, owing to the coming into operation of a new gravitation supply, and is all in excellent working condition:—

A COMPOUND ROTATIVE BEAM ENGINE, surface condensing, with bucket and plunger pumps, capacity 80,000 gallons per hour, with a total lift of 363ft., at a boiler pressure of 90 lb. per square inch; H.P. cylinder, 30in. dia. by 9ft. 10in. stroke; L.P. cylinder, 50in. dia. by 7ft. stroke; bucket, 7ft. stroke.

TWO TRIPLE-EXPANSION HORIZONTAL DUPLEX PUMPS; steam cylinders, 10in., 16in. and 28in. dia.; water cylinder, 14in. dia. by 18in. stroke; capacity (each), 45,000 gallons per hour against a head of 200ft. at a boiler pressure of 150 lb. per square inch.

TWO SURFACE CONDENSERS, Wheeler Admiralty Pattern, 2ft. 6in. dia. by 6ft. 10in. between tube plates, 433 ¾in. copper tubes (each), with steam-driven Horizontal Air Pumps complete.

TWO LANCASHIRE BOILERS, 28ft. by 7ft., by Tinlow Bros., insured for 150 lb. w.p.

ONE LANCASHIRE BOILER, by the Oldham Boiler Works Co., Ltd., insured for 100 lb. w.p.

TWO LANCASHIRE BOILERS, by the Oldham Boiler Works Co., Ltd., insured for 100 lb. w.p.

All the boilers above mentioned are fitted complete with Hopkinson valves and mountings.

Any further information and also permits to view the plant may be obtained from the BOROUGH WATER ENGINEER, 52, Balls-road, Birkenhead, to whom offers for the whole or portions of the plant should be sent not later than April 14th, 1922.

Water Engineer's Office,
15th March, 1922. 7751

The Swanage U.D. Council have FOR DISPOSAL the following SURPLUS PLANT:—

12 B.H.P. PORTABLE ENGINE, by Sykes and Co., No. 1254.
1 STEAM WINCH.
1 Medium-lift WORTHINGTON PUMP, 10 by 10½ by 10, No. 79,249.
1 High-lift WORTHINGTON PUMP, 18 by 5 by 18.
1 4 H.P. TANGYE OIL ENGINE.
2 400-Gallon TANKS.
1 WELL PUMP and RODS.
1 GALVANISED IRON SHED as erected.
1 SECTIONAL ARMY HUT, 60 by 15.
2750 FEET of 3in. STEEL MAIN.
3520 FEET of 6in. CAST IRON MAIN.

For further particulars apply
F. B. GOODMAN, M.I.M. and Cy. E.,
7682 Engineer to the above Council.

PUBLIC NOTICES

Tenders are Invited by the Government of New South Wales for the CONSTRUCTION of the SUPERSTRUCTURE and SUBSTRUCTURE of a CANTILEVER BRIDGE across Sydney Harbour from Dawes Point to Milson's Point, embracing a main span of 1600ft. in the clear, centre to centre of main piers, or 2690ft. centre to centre of anchor piers. The total length of bridge included in Tender is 3616ft., centre to centre of abutments. The deck of the bridge is to include four lines of railway, and a roadway 35ft. wide, between main trusses; and cantilevered outside the main trusses on the western side, a footway 15ft. wide, and on the eastern side a motor roadway 18ft. wide. Copies of specification, including plans, general conditions and schedule of quantities may be obtained on application to the undersigned.

To give any information required by tenderers, Mr. J. J. C. Bradfield, Chief Engineer, will be in London during June and July, 1922, address care of the undersigned.

Tenders in accordance with the specification must reach the Under Secretary for Public Works, Sydney, not later than 31st October, 1922.

AGENT-GENERAL
FOR NEW SOUTH WALES.
Australia House, Strand, London, W.C. 2,
December, 1921. 7096

Tyne Improvement Commission.
SWING BRIDGE, NEWCASTLE-UPON-TYNE.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the REPAIR of the GIRDER WORK of the SWINGING PORTION of the NEWCASTLE SWING BRIDGE.

Copies of the form of Tender, conditions of contract, specifications and drawings can be obtained from this office on payment of a deposit of Two Guineas. The deposit will be returned on receipt of a bona fide Tender with all the prescribed documents and drawings.

Tenders, in sealed envelopes, endorsed "Tender for Repairs, Newcastle Swing Bridge," to be addressed to the undersigned and delivered to him not later than Noon on Saturday, the 15th of April, 1922.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
J. McD. MANSON,
General Manager and Secretary.
Tyne Improvement Commission,
Newcastle-upon-Tyne,
22nd March, 1922. 7740

British North Borneo.

REQUIRED IMMEDIATELY, by the PUBLIC WORKS DEPARTMENT of NORTH BORNEO, TWO ENGINEERS.

Candidates should be single and under 30 years of age; active, of good physique, with thorough knowledge of instrument work and well trained in ordinary engineering knowledge; must have been trained in a recognised engineering college and should have passed A.M.I.C.E. exam. or hold exempting degree; should have had good practical experience on public works. Preference for one appointment will be given to candidate with waterworks experience.

Salary £490, rising annually by £31, with house or house allowance and duty allowance of £54. Five years' agreement, with first-class free passage out and home on completion of agreement. Appointment subject to medical examination.

Apply (in writing) not later than 3rd April, with full record of career in chronological order, giving age and details of general and technical education, training and subsequent experience, testimonials (copies only), service certificates, &c., to Messrs. RENDEL, PALMER and TRITTON, 12-14, Dartmouth-street, S.W. 1. 7662

Manchester Royal Infirmary.

QUALIFIED ENGINEER REQUIRED as FOREMAN in charge of the Maintenance of all Water, Heating and Steam Installations, Sterilising, Cooking, and Laundry Plant. Previous hospital experience an advantage. State age and salary required.

Apply by letter only to the GENERAL SUPERINTENDENT, Manchester Royal Infirmary,
17th March, 1922. 7730

Mersey Docks and Harbour BOARD.
GLADSTONE DOCK NEW WORKS.

The Board REQUIRE the SERVICES of a fully qualified RESIDENT ENGINEER under 40 years of age, who must be either a Member or an Associate Member of the Institution of Civil Engineers, to take charge of the above works, under the direction of the Engineer-in-Chief to the Board.

Candidates must have been in charge of Heavy Dock Construction Work and had experience in Reinforced Concrete Works, Steel Temporary Dams, Electrical Machinery of all descriptions, Steel Dock Gates, and Hydraulic Machinery.

Applications, with testimonials and stating salary required, to be addressed to the undersigned and delivered not later than April 10th, and marked on the envelope "Application for Resident Engineer."

L. A. F. WARNER,
General Manager and Secretary.
Dock Office, Liverpool,
March 20th, 1922. 7749

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SITUATIONS OPEN

WANTED by an English Firm Carrying Out Large building contract in the Far East, a qualified ASSISTANT of good education.
Applicants must possess extensive experience in the conduct of building operations in Reinforced Concrete, with a thorough knowledge of Quantity Surveying; preference given to a man who has been with a firm of contractors and has carried out similar work abroad. Age 25-35.
Strict medical examination required before appointment.
Address, with full particulars of career, enclosing copies of not more than two recent testimonials, 7736, The Engineer Office. 7736 A

WANTED by an English Firm Carrying Out Large building contract in the Far East, a WORKS FOREMAN.
Applicants must possess a thorough knowledge of *Ferro*-concrete Building Construction on a large scale, with a wide experience of handling labour.
Preference given to an unmarried man with the necessary experience, who has carried out similar work abroad with native labour. Age not over 40. Strict medical examination required before appointment.
Address, with full particulars of career, enclosing copies of not more than two recent testimonials, 7737, The Engineer Office. 7737 A

WANTED, SALESMAN, with Connection, Capable of handling Steam Specialities, Feed Pumps, &c. Salary and previous experience.—Address, 7619, The Engineer Office. 7618 A

AGENT or TRAVELLER, Calling on Engineering firms to introduce products of newly established scientifically controlled brassfoundry. Speciality brasses and special alloys. Financial interest possible, but not essential.—Address, P5160, The Engineer Office. P5160 A

AN ENGINEERING FIRM REQUIRE the SERVICES of a well-educated trained ENGINEER, who has specialised in Steam Generation, to act as Foreign Selling Representative. Knowledge of French and German essential; additional languages not absolutely necessary, but strong recommendation. Age between 25/30.—Address, giving full particulars of education, engineering training and experience, also state salary expected, 7729, The Engineer Office. 7729 A

ASSISTANT ENGINEER, with Office Experience, for Firm of Pump Makers, Westminster. Age, salary, experience.—Address, P5146, The Engineer Office. P5146 A

CEMENT WORKS MANAGER for the Midlands, with knowledge of Engineering; under 45 years of age. State when disengaged, experience, and salary required.—Address, 7762, The Engineer Office. 7762 A

CHEMIST and METALLURGIST REQUIRED, to Take Charge of Chemical, Metallurgical and Mechanical Testing Laboratories. Salary £400 per annum plus Civil Service bonus (at present £243). Applicants must possess recognised academical qualifications and have had experience of modern practice in the manufacture of iron and steel and non-ferrous metal alloys, and in the heat treatment of large and small masses of carbon and alloy steels; they must also have some knowledge of modern methods of mechanical testing.—Applications, giving particulars of qualifications and experience, should be addressed to CHIEF SUPERINTENDENT OF ORDNANCE FACTORIES, Royal Arsenal, Woolwich. 7725 A

HEATING ENGINEER (Young), of Good Education, WANTED. Only those having good experience in the design and supervision of up-to-date Heating and Ventilating Apparatus need apply. State age, experience, and salary required.—Address, 7744, The Engineer Office. 7744 A

LONDON REPRESENTATIVE WANTED by a Firm of Constructional Engineers in the North, to secure orders for Fit Tube, Light Railway Stock and Constructional Steel Work. To a suitable man the prospects are good and a high salary and bonus will be paid. Reply should state in confidence age, experience, references, and suggested remuneration.—Box 12228, Willing's, 36, King-street, Covent Garden, W.C. 2. 7761 A

TRAVELLER WANTED, to Sell Rawhide Pinions and Machine-cut Gears on commission to collieries in South Wales.
Also ONE DITTO for Notts, Derbyshire, and South Yorkshire.—Address, P5131, The Engineer Office. P5131 A

WORKS MANAGER REQUIRED for a Railway in Southern Brazil; salary 2:000$000 (2 contos of reis) a month. Age 30/35. Qualifications must include apprenticeship, drawing-office experience (at least two years), certified technical training. Experience in charge of workshops or equal. Knowledge of Portuguese, Spanish or French desirable.—Applicants should give full particulars of education, training and experience, by letter, to FOX and MAYO, Consulting Engineers, 155, Dashwood House, New Broad-street, London, E.C. 2. 7767 A

WANTED, DRAUGHTSMAN, Accustomed to Coal Screening or Washing Machinery. State full particulars and salary required.—Address, 7719, The Engineer Office. 7719 A

DRAUGHTSMAN WANTED, with Knowledge of Constructional Steel Work, able to take out quantities and estimates for works in small country town.—Write, stating experience and salary required, to "E. N.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 7763 A

DRAUGHTSMAN (Senior) REQUIRED, Fully qualified to design and estimate for constructional steel work and bridge work. State age, experience, salary required; strictly confidential.—Address, P5160, The Engineer Office. P5160 A

ASSISTANT or FOREMAN ENGINEER REQUIRED in a London Brewery, with good general experience steam and electrical. Age 28 to 35. Must be prepared to live on the premises; a reasonable rent will be charged for the accommodation.—Address, giving full particulars and stating salary required, P5166, The Engineer Office. P5166 A

SITUATIONS WANTED

ASSISTANT ENGINEER REQUIRES POSITION abroad; 30 years age, ex-Service man; 10 years shop and D.O. experience.—ROSE, 37, Endsleigh-gardens, Cranbrook Park, Ilford. P5164 B

BLAST FURNACES.—ASSISTANT MANAGER or GENERAL FOREMAN, 17 years' practical experience, well accustomed maintenance work and yard traffic; willing to go abroad; good refs.—Address, P5150, The Engineer Office. P5150 B

BUYING ENGINEER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 615, c/o Deacon's, Leadenhall-street, E.C. 3. 7764 B

ENGINEER (35), A.M.I.M.E., M.I.A.E., &c., Many years' experience works and business management, and with complete commercial experience, including sales organisation, experienced designer and with extensive knowledge of works accountancy, shortly relinquishing managing directorship, SEEKS responsible Managerial APPOINTMENT. Would entertain home, continental, or foreign representation.—Address, P4922, The Engineer Office. P4922 B

SITUATIONS WANTED (continued)

ADVISORY POST WANTED.

ADVERTISER, M.I. Mech. E., with Exceptional commercial and manufacturing experience at home and abroad, DESIRES a POST. Has successfully filled the position of director, general manager and works manager respectively in three of the largest firms in Great Britain. Can originate and carry through complete organisation of all departments. Moderate terms and would take a small interest to qualify as director in sound undertaking.—Address, P5174, The Engineer Office. P5174 B

ELECTRICIAN ENGINEER, 20 Years' Experience all branches, lights, motors, machines, &c.; any distance; motor cyclist; moderate rate.—S., 607, Wandsworth-road, S.W. 8. P5134 B

ENGINEER-CAPTAIN, R.N. (Retired), with Office in Glasgow, DESIRES WORK as Marine Superintending Engineer and inspection work, or would consider good agency.—Address, P5105, The Engineer Office. P5105 B

ENGINEER (30), 1st B.O.T., Experienced Marine, mech., elect., O.F. W.T. boilers, knowledge I.C.E., hydraulics, exc. refs., DESIRES APPOINTMENT in solid concern.—Address, P5107, The Engineer Office. P5107 B

ENGINEER (33), Mechanical and Electrical, Shop and drawing-office experience, SEEKS POSITION, maturing inventions, experimental or any other work.—A., 48, Argyle-road, Ilford. P5143 B

EUSTACE ARCHER, Civil Engineer, of 25 Years' standing (10 years in London), at present employed on important railway construction in Norway, SEEKS POSITION in Australia or New Zealand as Leading Engineer for location and construction of section or whole railway line. Excellent testimonials and college degree.—Reply, Box D 99, National Advertising Service, St. Ann's Chambers, Ludgate-hill, E.C. 4. 7368 B

EXPERIMENTAL ENGINEER, First-class Mechanic, designer and draughtsman, experienced in the designing and making of special apparatus for experimental and research work, DESIRES POSITION.—Address, P5179, The Engineer Office. P5179 B

EXPERIENCED DESIGNER, Shortly Disengaged, specialist in small and medium-sized mechanical designs for quantity production, including magnetos, lighting dynamos, electric controllers, motors, switches, &c. Familiar with present-day manufacturing methods.—Write, T. 75, Gravelly-lane, Erdington, Birmingham. P5170 B

GENTLEMAN (34), College, University, Apprentice, 17 years' experience, locomotive, motor car, jig and tools, highest references, DESIRES ENGINEERING APPOINTMENT.—Address, P5158, The Engineer Office. P5158 B

MECHANICAL ENGINEER (28), Articled, Sound technical training, 4 years' experience of works organisation and management, 6 years designer and chief draughtsman, shortly disengaged, REQUIRES responsible POSITION in progressive firm. Willing to invest moderate capital.—Address, P5102, The Engineer Office. P5102 B

MECHANICAL ENGINEER, with Good All-round general experience as foreman, cost clerk and manager, SEEKS responsible POST in any capacity, any district.—SNOAD, 36, York-road, Hitchin. P5163 B

WELL-KNOWN REPRESENTATIVE, of Good personality and ability, possessing considerable experience in elevating and conveying machinery, heavy quarry and mining machinery, steel and iron castings, DESIRES to HEAR from first-class FIRM requiring REPRESENTATION. Keen, progressive business man. Would consider commercial or sales managership. B.O.T. Cert., A.M.I. Mech. E.—Address, P5147, The Engineer Office. P5147 B

YOUNG ENGINEER (20), Well-educated, Two years at Crystal Palace School of Practical Engineering, SEEKS SITUATION in works or drawing-office to obtain experience.—12, Edgar-road, Sanderstead. P5159 B

DRAUGHTSMAN (Assistant), 7 Years' Experience, design and details, coal and coke-handling plant. Moderate salary.—B., 59, Oakfield-road, N. 4. P5176 B

DRAUGHTSMAN (35) DESIRES APPOINTMENT. Works and office experience in all types heating and ventilating plants, fans and dust collecting.—Address, P5178, The Engineer Office. P5173 B

DRAUGHTSMAN (22), Quick, Neat and Accurate, 6 years D.O. on automobile and aero-engines, jigs and tools, make own calculations, 3 years works.—E. CHANNING, 42, Litchfield-gardens, Willesden Green, 1. P5177 B

EXPERT DRAUGHTSMAN DESIGNER, at Present chief with well-known firm of engineers, DESIRES CHANGE; 15 yrs. experience, aero and marine engines, boat design, aircraft, general engineering, technical correspondence. Would accept low salary for progressive job, preferably on commercial side.—Address, P5175, The Engineer Office. P5175 B

TRACER (Male) SEEKS SITUATION; Good Experience, excellent reference; or would undertake work at home.—Apply, W. H. A., 7, New-street, E.C. 17. P5180 B

SECTION FOREMAN, Turning and Capstan Lathe specialist, tool-room or manufacturing, resident London, would Change for Permanency. Not trade unionist. Fullest particulars on request.—Address, P5156, The Engineer Office. P5156 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.

46, Watling Street, London, E.C. 4.

Established seventy years.

CAPITAL.—£5000 Available for Investment in Sound Business affording full-time occupation to investor.—Write, Box 1659, Bell's, 167, Fleet-street, E.C. 4. 7604 C

ENGINEER or GENTLEMAN with Capital REQUIRED to join another to form syndicate to develop several valuable patents; sound investment and good returns.—Address, P5130, The Engineer Office P5130 C

AGENCIES

ALFRED HERBERT LTD.
COVENTRY, ENGLAND.

We possess exceptional facilities for the sale of Engineering Goods of every description throughout the world and are prepared to negotiate for sole agencies.
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FRANCE—Soc. Anon. Alfred Herbert; Paris, Lyons, Lille.
BELGIUM—Soc. Anon. Belge Alfred Herbert: Brussels.
INDIA—Alfred Herbert (India), Ltd.: Calcutta, Bombay, Madras, Lahore, Rangoon.
ITALY—Soc. Anon. Ital. Alfred Herbert: Milan.
AUSTRALASIA—Alfred Herbert (Australasia), Ltd.: Sydney.
JAPAN—Yokohama, Tokio, Osaka.
CANADA—Toronto. 7364 D

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For continuation of For Sale Advertisements, see page iii.

Chinese Engineering Notes.

(From our own Correspondent.)

British engineers are watching with lively hopes the development of Chinese industries, and with the object of keeping them informed about the conditions in that vast country and the openings for their work and products, we have appointed a number of local correspondents, whose letters to us will be published from time to time. The first few of these notes we print below. Others will appear at intervals as the mails permit.

THE Chinese New Year—which this year began on January 28th—is always an anxious time for all concerned. An old custom in this country provides that all debts must be paid in full before that date, and for years it has been a struggle for the Chinese Government to obtain the necessary funds to meet its obligations. This year has been one of the worst, and up to the last moment it was very doubtful that the Government could obtain money enough to tide it over. However, arrangements were made at the eleventh hour for the issue of Treasury Notes, amply secured, and as the terms are attractive, the notes will be rapidly sold. Another feature of this New Year was the granting of a week's leave of absence to Premier Liang Shih Yi, apparently a preface to the resignation of that official. All attempts to conciliate the political factions have so far failed, and it is very unlikely that the present Cabinet will remain in office much longer.

Serious efforts are now being made in Peking to induce the Chinese authorities to appoint a representative Board to deal with the Yangtse River Conservancy, which presents one of the most important Chinese undertakings that will have to be faced sooner or later. China cannot tackle the job herself, and in view of the international shipping and commercial interests along the Yangtse River, the suggestion has been made that an international board shall be constituted to deal with the whole question. The Yangtse River is over 3000 miles long, traversing the provinces of Yunnan, Szechuan, Hupeh, Kiangsi, Anhui and Kiangsu, and rises in the centre of the high plateau of Tibet at an altitude of over 16,000ft. From Hankow to the mouth—a distance of 600 miles—the Yangtse is navigable during the spring, summer and autumn months by ocean-going steamers, but during the winter months only river steamers, drawing about 10ft., can reach Hankow. At that point the average high-water mark above a zero low level is about 42ft. Preliminary surveys and reports have been made by British and other experts, which are sufficiently encouraging to justify the Chinese Government in taking the matter up jointly with the foreign Powers concerned.

At one time it was thought that China was going to make a serious effort in the development of commercial aviation. Three years ago the Chinese Government ordered six large Handley Page Passenger-carrying machines and a few Avro training machines. A year later it entered into a contract with Vickers Limited for the supply of about one hundred Vickers-Vimy machines, and before Chinese pilots could be trained to fly any of the large machines, Peking was being inundated with aeroplanes which could not be used. A British Aviation Adviser was appointed by the Chinese Government, and several British, American and French pilots were engaged. A service between Peking and Shanghai was to be inaugurated last summer, but after a few trips between Peking and Tsinanfu—half way to Shanghai—the whole scheme was dropped owing to absence of funds. The lack of communications is responsible for the delay in opening up Chinese industries, and if the Government had spent the £2,000,000 on road building instead of on aeroplanes, some tangible results would have been obtained. Roads in China are almost unknown, but some of the provinces are realising their value and are endeavouring to raise funds for their construction.

The province of Manchuria has been very much neglected by British engineering firms. Japan, of course, is strongly entrenched there, but there is room for British enterprise. Electrical power plants, mining machinery and telephone materials always command a ready sale in this province, and it is a pity that British firms have not made an effort to get a share of this business.

The German Siemens Company is again in full swing throughout China, and all its old Chinese associates have gone back to it. It is building up a very powerful organisation throughout the country, and is working very closely with the Chinese merchants. Large stocks are being carried in the principal centres, and the prices are generally considerably below those of British and American firms.

Peking.

Politically, affairs in China to-day are worse than they have ever been, but it must not be supposed that trade is at a standstill. Within the past year the Chinese Government has defaulted on practically every foreign loan not enjoying a security under foreign control. A number of these loans were contracted as industrial loans, but the only security given by the Chinese Government was in the form of Treasury Notes in the currency of the country in which the loan was floated. The Chinese Government Treasury to-day is empty, but efforts are being made to contract a loan with the International Consortium. Such a loan is absolutely necessary, but the terms that will be insisted upon by the Consortium will be such that a great deal of opposition will arise from certain sections of the Chinese. Such opposition, however, is generally political, and directed against the Cabinet for the time being. Under present conditions, business with the Chinese Government is impossible. Plenty of orders can be obtained, provided one has the necessary influence, but payment is quite another thing. Various engineering organisations are, however, making preparations for the future, German firms being the most energetic. Occasionally one hears the opinion expressed that it is better to wait until conditions are more settled rather than attempt to organise for the future. This is a very great mistake and Germans are taking advantage of the people who hold these views. The foreign Powers have too much at stake to allow China to continue on its present downward path. One of the conditions most likely to be laid down in the next Consortium loan agreement will be a very considerable reduction in China's army. In addition to a considerable saving in expenditure, this will have the effect of preventing odd "revolutions" occurring from time to time, which disturbances are bound to hold up trade to a certain extent. Out of an army of well over 1,000,000 men, the central Government does not actually control more than 75,000. The remainder are under the control of the Tuchuns (provincial military governors), most of whom are quite independent, but the central Government has to pay for their maintenance, because revenue which was formally remitted by the provinces to the central Government is now held by the Tuchuns. It is a curious thing—and this is worth noting by the British manufacturer—that in spite of the adverse conditions that have prevailed during the past year, the volume of China's foreign trade has increased by no less than 5,000,000 taels (say, £1,000,000) over the corresponding period of the previous year. The political conditions in China very rarely affect trade in such places as Shanghai, Hankow, Tientsin, Canton and Mukden, and it is a great pity that the British manufacturer is not making greater efforts to maintain the supremacy which we have always enjoyed. Numbers of those who are trying to make these efforts are groping in the dark. The manufacturer does not yet know how to market his commodities in China. Several systems are in force, and the most popular one seems to be to form groups—some of a non-competitive nature and others competitive—but so far as one can see they have never come up to expectations. There is only one way for the manufacturer to get orders in China, and that is through direct representation by people who know the country. Such representatives should, if possible, have the assistance of an up-to-date technical man from home. Here, again, great care should be taken in selecting the technical man. He should be a man who is willing to learn the language, put up with numerous disappointments, and possess the only asset worth having in China—patience. Twenty years ago it was quite sufficient to appoint an old-established firm to act as agent for the manufacturer. It cost the manufacturer nothing, and all the agent did was to put another name-plate over his door, and business would come with the assistance of the Compradore (Chinese manager). To-day, things are different. There is so much competition that one has to go out and get the business, and if the agent represents dozens of manufacturers he is quite unable to do it efficiently. The British manufacturer is handicapped in China as regards banking facilities. We are practically the only nation not having an industrial bank. Most of the other nations have organised industrial banks jointly with either the Chinese Government, influential members of the Government, or Chinese of good standing. The tendency nowadays is to co-operate more closely with the Chinese people. This is not always possible in the case of an agent for a manufacturer, but it is being done very successfully in industrial enterprises in the interior of China, such as mining, electric power plants, waterworks, &c. &c.

Shanghai.

China has been trading with the world for about a hundred years, and the rate of increase of that trade has been averaging 10 per cent. per annum, and as the requirements of the country are still very inadequately supplied, taking the requirements of other countries as a basis of comparison, the trade can go on increasing for at least another hundred years at the rate of 10 per cent. per annum before China is taking the same quantity of imported articles as other countries are doing now. The probabilities are that China will more rapidly come up to the level of other countries in trade requirements as she grows in what is termed "Western ideas," as she is undoubtedly growing. The great increase in the cotton spinning and flour milling industries during the last few years are indications of the westernising of this vast country. The cotton spinning mills are adding weaving plants, and they have also had a good effect on the cotton growing industry.

There is no doubt that China will accomplish political peace—if such a desirable state is ever again to occur in any country—through industrial development, and there are several notable examples in China of centres of industry growing apace. In these centres and in the districts around them, there is contentment and order, and the officials and leading men responsible for the creation of these centres carry great weight in the counsels of the Government, and the Chinese merchant believes implicitly in them. That the Powers will assist China in fostering the endeavours of her leading industrialists is sure, and it is quite reasonable to suppose that any Chinese Government which can show itself willing to handle any development work honestly and unmonopolistically will receive the financial support of the industrialists of the powerful nations.

The impression in the home countries is that China is full of revolutions, with fighting going on whenever it is fine, and with bandits roving at any distance from guarded centres. This is so, but it makes no difference. It has always been so, and whilst the reports of these distressing occurrences sound alarming to people at home, actually the fighting and bandit work are carefully arranged, as a rule, and trade is not interfered with seriously. The only drawback to trade due to this state of affairs is that it costs more to get the goods to the people. With the abolition of Likin and with railway and road construction increasing, the fighting and bandit business will gradually disappear, as has been proved in other countries. China is only a century or so behind the times according to Western ideas, but with a wisdom which is not always apparent is sifting the methods of other nations in their process of development, and will no doubt adopt the methods best suited to her national character. It therefore behoves us to bestir ourselves and work with the Chinese and try to understand them in order to obtain their co-operation in trade. In many ways the Chinese are like Britons, so there ought not to be much difficulty in the two nations getting together.

Chinese Brine Wells.

OVER seven hundred years ago Marco Polo commented on the extent of the salt industry of China, which, he estimated, produced a revenue represented by some £3,200,000 of our present-day money, and remarked on the antiquity of the processes employed in producing the salt. The industry is still carried on in almost precisely the same manner, but has grown very considerably in the interval. The latest reliable statistics are those for 1916, which show that the revenue to the State derived from the salt tax amounted to £7,800,000, while the output from the principal producing district was over 300,000 tons a year.

The photographs which we reproduce on page 332 and in our Supplement were taken in one of the districts where the salt industry has been developed very intensely, and illustrate very plainly how crude-looking to European eyes is the apparatus employed by the Chinese. It enables them, nevertheless, to produce salt and sell it at a profit at from 25 to 60 cash per catty (say, ¾d. to 1½d. per pound), and this salt is made from brine which has to be raised from a depth of 1000ft. or so below ground. Such an achievement is, of course, only possible with cheap labour, but it should be borne in mind that the price of labour is increasing rapidly in the Far East, and although that movement may not yet be so marked in the interior of China as it is nearer the coast, the time will probably soon come when labour-saving devices will have to be introduced into this ancient industry if the price of salt is to be kept at its present level. On the other hand, the innate dilatoriness of the Chinese, together with incessant litigation, often occupy so much time, which could otherwise be devoted to actual work, that it is questionable as to whether or not the capital expenditure on machinery could be justified.

The brine wells of China vary very greatly in depth. Some are so shallow that the brine can be dipped out of them in a hollow only a few feet below the general ground level, but there are others 3000ft. deep, and brine is found at one place or another at various intervening levels. The deep wells are mostly bored through a comparatively soft sandstone, and although the drilling gear is very crude, the speed of sinking is generally about 3ft. per twenty-four hours. At this rate of progress a deep well should be completed in, say, three years, but it is not uncommon for the operation to be drawn out to a length of twenty or thirty years, and frequently it is not until the second generation that the benefit of a man's enterprise in sinking a well is realised.

A remarkable feature about these wells is the uncertainty as to whether they will tap brine or natural gas, but as the two products are interdependent—the gas being used in evaporating the brine—the risk is not of much import. Gas is generally struck much nearer the surface than is brine, and if there is a local demand for it the boring is stopped and the gas is utilised. If, on the other hand, there is no immediate demand for the gas, the well is capped and furnished with jets made of bamboo coated with lime, as shown in Fig. 5, and the gas is burned to waste. Generally

speaking, however, only about one-third of the wells strike gas, and that at a level of from 600ft. to 800ft. The gas burns with a white flame, indicating the presence of hydro-carbons, and the flow from one well is sufficient to supply about fifteen evaporating pans. Sometimes, however, gas is met as deep as 2000ft., and then the flow is so strong that from 600 to 1200 pans can be kept going. These deep wells produce a gas which burns with a blue flame.

The quality of the brine also varies very considerably with the depth of the well. In the shallow bores it is of a dirty yellow colour, but changes to black in the deep holes. The light-coloured brine holds some 7 per cent. of salt, while that from the deep bores may contain as much as 13 per cent. The procedure in drilling is always the same, as the primary object is to obtain brine. An open well is first dug to reach the sandstone, and it may be necessary to go down 200ft. for this purpose. The well is then lined with cypress logs, which are cut in halves and channelled out to give a round bore about 10in. in diameter when the two halves are clamped together again. The logs are approximately 6ft. long and are set in the well with the greatest care, so that the drilling tools may be guided properly. A stone cap with a hole in the centre is set on the top of the wooden lining as a wearing piece.

At this stage the drilling rig is set up over the hole, and it always takes the form shown in Fig. 2. There is a tripod with a sheave at the top for the bailing rope, and between two of its legs there is a frame carrying the pivot of a beam used to give the drilling bit its up-and-down motion. Alongside of the beam there are two gangways, on which coolies stand, and they work the beam by striding from one gangway to the other, using the beam as a step in doing so. As they put their weight on the beam it is depressed, and as they step off briskly it rises and lets the tools attached to the other end drop in the bore-hole. The men turn round and repeat the movement at the rate of from twelve to fifteen strokes per minute. This plan has the great advantage that, not only is coolie labour very cheap, but also that the power supply can be adjusted to suit the work in hand. Thus as the well gets deeper and the weight of ropes and tools to b raised at each stroke increases, more coolies are hired to work the beam.

The tool or jumper weighs about 100 lb. and is fixed to a bamboo loaded inside with iron. A loose joint or jar is arranged between the two parts, so that after the tool itself has hit the bottom of the hole and given its blow it is followed by the weight above and a second blow given. The string of tools is attached to a rope made of strips of bamboo, which is tied to a heart-shaped swivel on the working end of the beam. At each stroke the rope is given a quarter turn by the man seen sitting on the stool in the picture. Every now and then the rope is lengthened by lashing on extra strips of bamboo, and during this process the coolies on the beam get a rest. The sand or sludge made by the drill is pumped out by lowering a bailer, made of a length of bamboo, in the place of the tools and jerking it up and down, so that the sand enters by a valve at the bottom. The bailer is then drawn up by a windlass worked by buffaloes.

If fresh water is struck during boring or after the

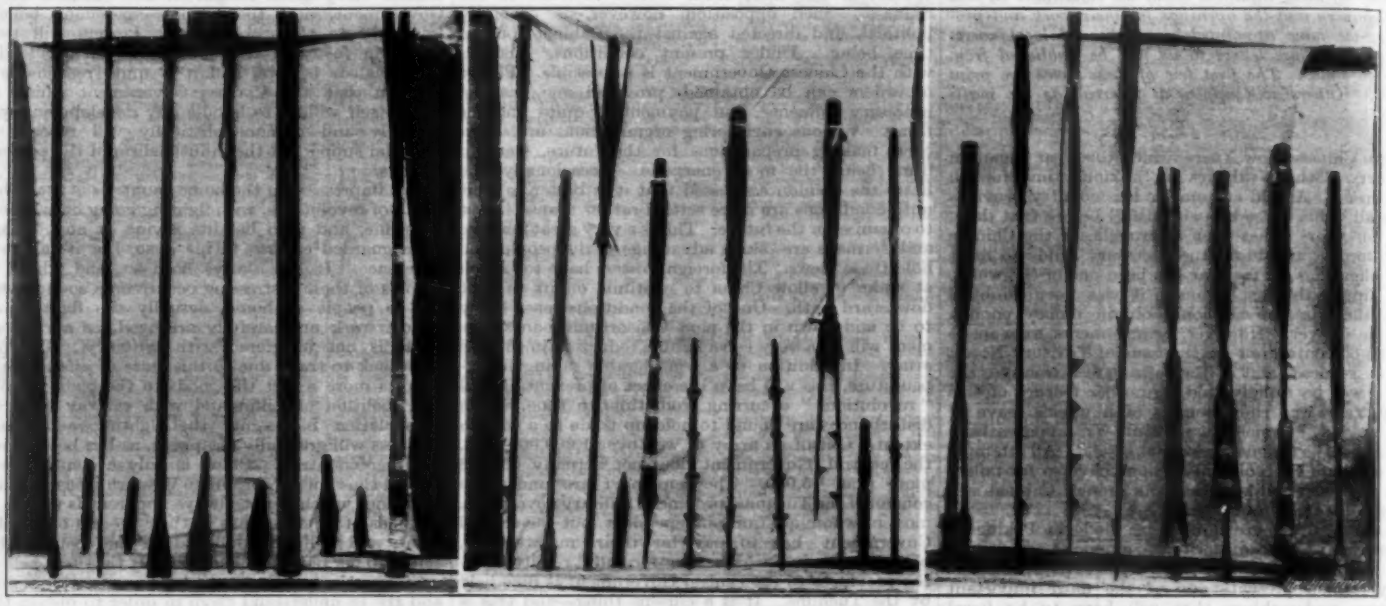


FIG. 1—BORING TOOLS, A BAMBOO BAILER, AND IMPLEMENTS FOR RECOVERING LOST ROPES

FIG. 2—BRINE WELL BORING RIG

FIG. 3—GAS-FIRED EVAPORATING PANS

FIG. 4—GOVERNMENT OFFICER WEIGHING SALT

well is at work a plug of grass is driven down the hole below the leak and lime cement is poured on the top. When the cement has set and sealed off the water the boring is gone on with, being first carried through the cement plug.

When the well has been sunk to the requisite depth the drilling gear is dismantled, but the tripod is left, as the brine always has to be bailed out of these wells. It will be noticed from the illustrations that the tripods are all built up of small timbers lashed together with rope. This construction is made necessary by the complete absence of reasonably large trees. It is unusual to see a native pole more than 8in. in diameter at the butt, and even then the first few feet are not of much service, as the trees are grown on the hillsides, with the result that they have a bend at the bottom where they emerge from the undergrowth and turn up towards the sky. The poles also taper very sharply so that their useful length is not great.

While speaking of the timber tripods it may be of interest to describe the bamboo ropes used for hoisting the bailers. Bamboo ropes are made in all sizes from about ¾in. in diameter, or a little more, for bailing up to, say, 6in. for mooring heavy rafts. The bamboos are split into long strips by drawing them over fixed knives while they are still green with sap and wet through from being rafted down the river. These strips are then plaited together like a piece of hollow braid, only with a very small hole through the centre, by men working at the top of tall towers. The loose ends of the strips flop about in the air on one side of the tower as they are plaited together, while the finished rope slips down the other side and is coiled up on the ground. These ropes are very strong and remarkably flexible when they are new. They must not, of course, be kinked, but can be tied in knots with fairly large round turns. They are not nearly so harsh to handle as might be expected, and will reeve through pulleys having good big sheaves.

FIG. 5—CLAY BURNERS AT TOP OF GAS WELL

To return to the salt well. The brine is raised in bailers made of bamboo, one of which is shown in Fig. 1. They are generally about 4in. in diameter and go up to 120ft. long. Such a bailer will hold some 650 lb. of brine, and the hydrostatic pressure at the bottom is so great that the bamboo has to be bound with twine, as shown in the picture. At the bottom of the bailer there is a non-return valve, through which the brine enters when it is lowered into the well. The windlass used to draw up the bailer is shown in the Supplement. It is about 6ft. high by 20ft. in circumference and is arranged in a frame high enough to keep the rope clear above the buffaloes which work the windlass. At the commencement of the wind, when the weight of all the rope has to be raised, the buffaloes walk round at a moderate speed, but as the load lightens the drivers urge on the beasts, in no gentle manner, until they finish at a gallop. The water buffalo is not naturally agile, and it takes about fifteen minutes to complete a wind. After bringing the bailer to the surface the beasts are unhitched and taken away to rest, while another team takes their place. A man stationed at the well head draws the bailer clear of the bore-hole and drags it to one side over a funnel. He then opens the foot valve by thrusting it up with an iron rod and discharges the brine into the funnel—see Supplement. One or two desultory attempts have been made in the past to introduce machinery for bailing the brine wells, but none of them, we believe, have been very successful.

Various means are adopted in conveying the brine to the evaporating establishments, which are grouped near the gas wells. If the distance is only short the brine is dipped out of a cistern at the well and carried up trestles by coolies, as shown in the Supplement. At the top of the trestle there is a tank from which bamboo pipes radiate to the evaporators. The height of the tank provides sufficient head to overcome friction in the pipes and any difference in level in the pipe line. The bamboo pipes are bound round with strip bamboo to keep them tight, which gives them the tassled appearance shown in the pictures. If a hill has to be surmounted the brine is taken over by a series of chain pumps worked by horses in tread-mills. Some of these lifts are shown in the Supplement.

When the brine has to be conveyed greater distances than is thought advisable by pipe line, it is carried in boats on the rivers which traverse the district in all directions. These rivers are subject to considerable seasonal variation in level, and during low water, as shown in Fig. 6, they are dammed to provide sufficient draught for the boats. The dams are, however, seldom navigable and the loads must be transhipped at each of them. The brine is pumped out of the boats by chain pumps of the type shown in the Supplement. These pumps comprise a wooden chain on which there are transverse boards that make a good fit in a wooden trough. The chain runs over sprockets at each end of the trough and the upper one is fitted with a tread wheel. The brine is, of course, drawn up the trough by the boards. Considering the crude way these lifts are put together, without any metal in their construction, it is surprising how effective they are.

The evaporating process is simple in the extreme and could probably be improved in efficiency enormously. The brine is led from storage tanks into cast iron pans, see Fig. 3, about 4ft. in diameter, with flat bottoms some 3in. thick. The pans weigh 1600 lb. each and frequently crack, so that they must be replaced or repaired on the average once a fortnight. Underneath the pan there is a conical jet, made of clay, at which the natural gas is burned. The gas is led to the burners in bamboo pipes which are coated with lime cement to keep them as gas-tight as possible. During the process of boiling a decoction of beans is added to the brine, with the result that a large part of the impurities rise to the surface and can be skimmed off.

On account of the importance of the tax levied on the industry by the Government, the subsequent handling of the salt is supervised by a whole army of officials, but does not involve any processes of engineering interest. Some of our illustrations, however, depict scenes during the transport of the salt to market.

Institution of Mechanical Engineers.

BRITISH AND AMERICAN LOCOMOTIVES.

THE Institution of Mechanical Engineers met on Friday, March 17th, at Storey's-gate, to discuss a paper on "British and American Locomotive Design and Practice," contributed by Mr. P. C. Dewhurst, Locomotive, Carriage and Wagon Superintendent of the Jamaica Government Railways. Dr. H. S. Hele-Shaw, the President, took the chair, and in presenting the minutes of the proceedings at the previous meeting, pointed out that although legal opinion was to the effect that the new by-laws—outlined in our issues of January 27th and February 24th—did not necessarily come into force until the end of the year, it had been decided to elect as a member of Council, and in the place of Sir Henry Fowler, who became Vice-president, Mr. W. F. Cully, associate member.

In view of the fact that Mr. Dewhurst was resident in Jamaica, and could not be present at the meeting to read his paper, a *précis* of which we give on page 335, Dr. Hele-Shaw invited Lieut.-Colonel E. Kitson Clark to present the paper for him.

Colonel Clark said that he knew Mr. Dewhurst personally as a man with a very wide experience of railway engineering, embracing all classes of locomotives, rails and wagons, and considered that his unbiassed opinion, backed by that wide experience, made the paper a most valuable addition to the "Transactions" of the Institution. In skimming over the paper, Colonel Clark occasionally interposed a few remarks of his own, pointing out, for instance, that the problem of the lateral flexibility of locomotive frames had by no means been fully thrashed out. He considered that the English plate frame should be likened to a very rigid box girder, while the bar frames of America resembled rather two separate girders. He thought that Mr. Dewhurst had brought forward a very important subject in showing the comparative unpopularity of tank engines in America, and emphasised the author's contention that it is a good thing to make the engine and tender as one unit on one frame. As regards the controversy concerning the relative merits of basic and acid steel for locomotive boilers, Colonel Clark said that he had no experience with the former, but he advocated the use of steel for fire-boxes. In speaking of fire-boxes, he also suggested that English locomotive engineers were too liable to be guided by precedent, and that although the Belpaire fire-box had served a most useful turn, the time had come when consideration might be given profitably to a return to the direct-stayed round top fire-box, which was much cheaper to manufacture.

In inviting Sir Henry Fowler to open the discussion, the President said that the paper would evoke a large amount of discussion, and it might be desirable to adjourn the meeting to continue the discussion. It was ultimately decided to do so, and the meeting was subsequently adjourned to March 24th, at 6 p.m.

Sir Henry Fowler said that in examining the paper one had to decide whether the relative merits of British and American locomotives were to be discussed from the point of view of Mr. Dewhurst, that is to say, as they would appeal to the user in Jamaica; or were they to consider the engines as at service in their respective native countries, for the conditions were totally dissimilar. Thus in America the loading gauges were very generous and gave the locomotive designer ample latitude, whereas the loading gauge in this country was very confined, and the multitude of bridges set a limit to the weight of engines. He did not think that the capital cost of strengthening all these bridges would be justified by the economies which might be effected in running by the use of heavier locomotives, and the only case in which it had been found advisable to adopt ten-coupled wheels in this country was presented by a solitary Midland locomotive, of which the sphere of action was comparatively limited. The capital cost of alterations was in the way also of adopting larger wagons. In that case it was not only a question of the loading gauge on the railways; there would have to be alterations at all the wharves and warehouses in the country too. In this connection, Sir Henry said that British locomotive engineers ought to be grateful for the artistic touch which induced George Stephenson to put an ornamental crown on the top of the Rocket's funnel, and thus added a few extra inches to the first loading gauge. In contradistinction to these restrictions the American designers were able comfortably to arrange their cylinders outside the frames, as there were no platforms to get in the way. They could also employ large boilers, which was a great advantage, as it allowed the coal to be burned slowly, and thus improved efficiency.

Sir Henry Fowler said that he had found basic steel quite satisfactory if it was made properly, and drew a sketch on the blackboard to show how a $^{5}/_{16}$in. plate of basic steel was flanged out at the Derby works to a depth of 16in. Sir Henry was not at all in favour of steel fire-boxes. A number he examined that morning were all wasted away in the lower part. His company was not much troubled with the corrosion of steam pipes, except in the case of some classes of brass pipes; for fire tubes, however, he did not find steel satisfactory, and steel tubes were always replaced with copper as soon as possible. There were on the Midland railway about three copper tubes for every steel tube, but the casualties were of the order of one copper tube to ten steel tubes. Fusible plugs were, he considered, a good safeguard against low water, so long as they were well made. The best way of getting the fusible alloy into intimate contact with the shell was to pour it in, let it cool, and then re-melt it in place. Mr. Dewhurst had mentioned trouble with joints in superheaters, but Sir Henry had found that a completely satisfactory joint could be made with a copper ring of diamond-shaped section. The author said that the American allowance of 1 in 750 for shrinking tires on to wheels was about 50 per cent. greater than the British allowance. The practice on the Midland Railway was to allow 1 in 1100, and he found that that was ample to keep the tire in place. He had tried a mixture of horsehair and cotton waste for lubricating purposes in axle boxes, but as the horsehair tended to ball up and choke the oil ways, it had been given up. Sir Henry did not seem to be in agreement with Colonel Kitson Clark as to the merits of the direct-stay round top fire-box, and said that they were being replaced on the Midland Railway by Belpaire boxes.

Mr. Sanderson, of the Baldwin Locomotive Company, said that the first thing which struck him on reading Mr. Dewhurst's paper was the fact that the author was evidently not up to date in American

practice; but that was inevitable, as there was no opportunity on the Jamaica railways for employing modern large American locomotives, and the American works had almost ceased to build the smaller type of engine which would be suitable for such lines. It was a mistake, however, to imagine that the manufacturers of his country only turned out locomotives to stock patterns, as used to be the case both in America and England, as the designs were always nowadays settled by the railway engineers. Sometimes the purchaser's engineers might be assisted by his company's drawing-office staff, but generally the works were supplied with a complete set of working drawings. The practice of using flangeless wheels to overcome the objection to long rigid wheel bases had been practically abandoned in America, except for shunting engines of the 0–6–0 and 2–10–2 types, but the flanges on the front and back wheels were set in slightly to give the necessary play. Mr. Sanderson agreed with the author that it was better to use two large cylinders rather than three or four smaller ones, and said that the American makers had found the two-cylinder arrangement more economical. The reason why tank engines were not used in the United States was their lack of capacity. If they were used for shunting service there they would have to handle trains of from three to seven thousand tons weight, and it would not be possible to provide sufficient water-tank capacity to keep them going for a whole shift, so that time would be wasted whilst the engine went to fill up with water. It had been suggested that outside cylinders would cause large powerful engines to "nose" badly, but it should be borne in mind that a large locomotive was like a long pendulum, and its period of oscillation was so great, as compared with the rate of reciprocation of the pistons, that it had an important steadying effect, and, as a matter of fact, no trouble was experienced on that account.

In discussing the relative merits of plate and bar frames, Mr. Sanderson said that he did not believe that the plate frame really did give laterally as the locomotive rounded a curve, since the plates would soon crack if it did so. The bar frame, he thought, should be taken as a whole, and not as two independent girders. The two side frames were rigidly braced together, and he considered that the proper practice was to make the frame as stiff as possible, while providing, outside the frame, the required flexibility. The practice of using "pedestal stays" for tying together the lower ends of the horn cheeks had been abandoned in America, as it had been found that the through bolts, which were used for the purpose and were tightened up against distance pieces, stretched in service and ceased to provide any support. An arrangement rather more similar to British practice, using a solid stay drawn up into place against taper pieces, was now used. Cast iron shoes lined with brass were used. They were made by pouring the two metals together into the mould, a process which, Mr. Sanderson said, it was quite easy to carry out. He was strongly in favour of large boilers, although they entailed the addition of trailers for carrying the extra weight, as they permitted the coal being burned to much greater advantage than was possible if the same service was forced out of a smaller boiler. Mr. Sanderson promised to extend his remarks in writing.

Captain H. Beames, of the London and North-Western Railway, said that an arrangement for tightening up the horn cheeks was not altogether an unmixed blessing, as it gave a careless workman an opportunity, in re-erecting an engine, of pulling the frame out of shape, and getting the axles out of line. Mr. Webb had, in fact, proved that it was possible to extend the frame of a six-coupled locomotive by one-sixteenth of an inch. There was no necessity, he said, to put collars on axles to take up side thrust, and engines really ran more satisfactorily when the thrust was taken by the boss of the wheel bearing against the axle-box. In speaking of water tubes in fire-boxes, Captain Beames said that he had tried the Nicholson thermic system for improving circulation, but had not found it to be of any great assistance. He had also, he said, tried a blast pipe somewhat similar to that described by the author, in which the orifice was divided by wings, but found that it required constant attention in the way of cleaning. Some of the engine drivers evidently thought that a divided blast was superior to a single jet, as he knew of a case in which a cold chisel had been set across the mouth of the pipe to split up the jet. Unfortunately, it fell down into the valve-box and wrecked the slide valve. He also had tried horsehair and waste for axle-box lubrication, but did not find it very satisfactory, and it was sure to get spoiled if a locomotive was lifted and the weight of the wheels and axles came on the hair. He had also tried grease lubrication, both for axle-boxes and big ends, but found that oil was best for heavy service. Worsted trimmings in oil boxes did not, however, syphon over the oil at a regular rate, and the flow tended to slow up as the level in the box fell. It was thus necessary to provide a box large enough to leave the oil level sufficiently high at the end of a journey to provide an adequate flow to the bearings. Captain Beames also gave the results of some experiments on safety valves, which are of special interest in connection with the recent controversy over the Buxton explosion. These experiments were carried out on a 3in. Ramsbottom valve having three wings. At ordinary workshop temperature it was just binding when the clearance was 3/1000in., but it was quite free at 5/1000in. The valve was then immersed in cold water, with the result that it stuck fast with a clearance of 6/1000in., but was free at 8/1000in. When standing in ice water the valve was free with 9½/1000in. clearance, and when subject to a blast of cold air representing a wind of 32 miles per hour and 8½ deg. of frost, it was free at 8/1000in. It was noteworthy that as a result of all this treatment the bush of the valve was reduced in diameter by 2/1000in.

Mr. J. A. Hookham, North Staffordshire Railway, claimed that there were more steel boiler tubes in use in English and American locomotives than there were brass or copper, and suggested that the reason why American engineers were able to get satisfactory service out of steel fire-boxes was that they did not have to force their boilers so hard. Fusible plugs, he thought, were not of much value, and as to dampers, the North Staffordshire Railway discarded them long ago. Some spark-arresters were supposed to improve the distribution of the draught through the tubes, but he had not yet found one to do so. He took exception to the Ramsbottom type of safety valve on account of the excess of steam pressure necessary to keep it open, and said that Mr. Pickersgill had found that the excess pressure might be as great as 30 lb. per square inch with a boiler steaming hard. His railway was now adopting safety valves of the Ross type. Mr. Hookham disagreed with the practice of fixing tires on to wheels by means of set screws, as it weakened the tire, and he doubted if it really was necessary, since the tire was held in place by the lip on one side and the flange bearing against the rail on the other. As a matter of fact, plenty of locomotive tires were actually loose and yet came to no harm.

In concluding the discussion for that evening, Lieut.-Colonel Kitson Clark made a few further remarks, during which he suggested that it would be a good thing to investigate the strength of bolts, as there always was a liability for men to tighten them up so hard as to weaken them. The meeting was then adjourned, as already mentioned, until March 24th (to-day), at 6 p.m.

Before the general meeting, a meeting of the Benevolent Fund of the Institution was held. It was reported that during the year the membership had been increased by 170 ordinary members and two life members, and that the total roll on December 31st was 614. The total Benevolent Fund on that date amounted to £11,253 6s. In moving the adoption of the report, Mr. Michael Longridge expressed regret that such a small proportion of the members of the Institution were also members of the Fund, and made an urgent appeal for annual donations, even if they were small in amount. If every member would promise no more than half a crown a year the Fund would soon be in such a position that it could deal more generously than was now possible with those who called upon it.

British Industries Fair at Birmingham.

No. IV.*

We conclude below our account of exhibits at the Birmingham Section of the British Industries Fair.

Small Motors.

Some handy little motors were shown on the stand of Accles and Shelvoke, Limited, of Talford-street Works, Aston, Birmingham. They were of the direct-current type, both open and enclosed, and gave from 1/10 up to ¼ horse-power. There were also some "dynamotors," which were originally devised for polishing and plating work. The ¼ horse-power size is capable of giving 18 ampères at 6½ volts, or driving a couple of polishing mops. The taper screws used for chucking the mops are fitted on Morse tapers on the armature spindle, and can thus be very quickly changed. There were several machines on the stand driven by these "Acvoke" motors, including a rotoplunge pump capable of delivering 300 gallons of water per hour against a head of 50ft., and a ram pump for 100ft. head and 250 gallons per hour. A new type of riddle for foundry service, made by the Adaptable Moulding Machine Company, of Birmingham, and driven by a ¼ horse-power motor, was also exhibited on this stand.

Drawing Presses.

Taylor and Challen, Limited, of Derwent Works, Birmingham, had a large stand on which there were exhibited several types of drawing and notching presses, together with a lathe for spinning light sheet metal. The presses were of both the vertical and inclinable types and for pressing articles in metal up to No. 16 gauge and measuring up to 10in. in diameter or 5in. deep. The inclinable presses are mounted on stools by means of bolts passing through arc-shaped slots, so that the press table can be tilted back and the articles will drop out at the rear as fast as they are made. Another heavier type of press with gearing to increase the purchase on the dies and with front stays to tie the table and press head together was shown. These presses only weigh some 47 cwt. but are capable of exerting a pressure of 40 tons in cutting out blanks. A self-feeding press was fitted with double sets of feed rolls, on opposite sides of the table, so that when the leading set of rolls loses its grip on the stock, at the end of the run, the other set of rolls takes control and finishes the feeding right to the end of the stock. This press is very handy for cutting out washers in one operation. The notching presses are used for cutting out armature laminations and similar work. They are provided with a mechanism which locks the dividing wheel at every stroke before punching, and can be worked in the case of some of the smaller sizes up to speeds of 250 strokes per minute.

Coal Washers.

An interesting stand was that of the Rhondda Engineering and Mining Company, Limited, of Bridgend, South Wales. On it there were three units of the Draper coal washer, together with a glass model of the apparatus, shown at work to demonstrate the principle. The diagram Fig. 21 gives an idea of the scheme. The unwashed coal is fed into the top through a shoot, while a stream of water flows upwards through the casing and over a weir at the top. The speed of this stream of water is so regulated that it will just carry along the coal, but allow the heavier shale to fall to the bottom. The coal is carried over the weir, at the top, with the water, which is used in the apparatus over and over again. A rotary trap at the bottom permits the discharge of the refuse without allowing too much water to pass. By slightly

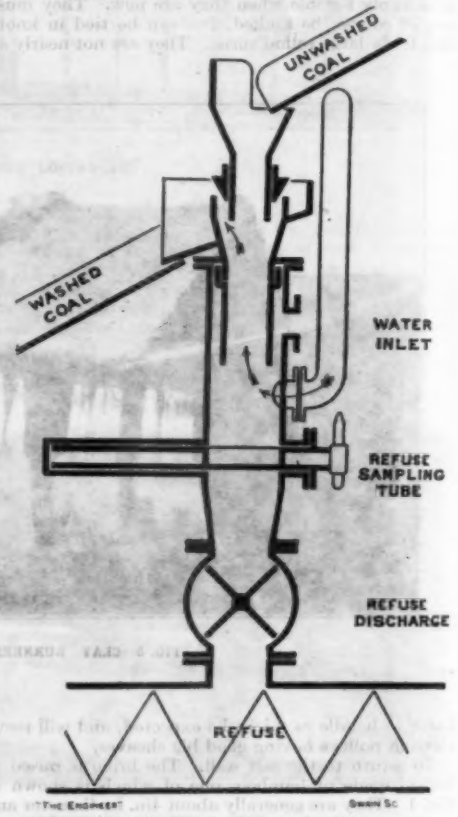


FIG. 21—DIAGRAM OF DRAPER COAL WASHER

modifying the arrangement of the outlet weir these washers can be adapted to handle coal from 3in. nuts down to duff so fine that it will pass a screen with 100 meshes per lineal inch. The makers say that with most classes of coal they can bring down the ash content to 1 per cent., while no more than 1 per cent. of coal will be found to have been lost with the refuse. Each unit of the Draper washer is capable of handling 5 tons per hour, and three such units occupy only 5ft. 3in. by 2ft. of floor space.

Oil Engines.

The Heatly-Gresham Engineering Company, Limited, of Letchworth, had a number of oil engines ranging up to about 20 horse-power, including one direct-coupled to a centrifugal pump, for the India Office, capable of delivering 36,000 gallons per hour against 50ft. head when running at 835 revolutions per minute. Another little 3 horse-power single-cylinder engine was connected with an exhauster able to handle 50 cubic feet of air per minute, and producing, we were told, a vacuum within ½in. of the barometric pressure. This little machine has been devised for installation in train running sheds, so that the brake gear may be tested while the carriages are being cleaned.

Stainless Steel.

There was a very fine demonstration of the multitude of uses to which stainless steel can be put to be seen on the stand of the Firth-Brearley Stainless Steel Syndicate, of 1, George-street, Sheffield. The

* No. III. appeared March 17th.

syndicate does not, of course, work up the metal into any great variety of finished products, preferring, rather, to supply manufacturers with the metal in the rough state. There were, however, all kinds of articles on the stand made of stainless steel, from scissors and digging spades to turbine blading, pump rods, &c. The blading was some of that which was described in THE ENGINEER quite recently, and showed very plainly the superior resistance of stainless steel to corrosion, as compared with the more usual grades of steel. In the case of pump rods it has been shown by actual experience that a rod of stainless steel will only wear away to the extent of $^1/_{64}$in. during the same time that a phosphor-bronze rod would lose $^7/_{64}$in. in diameter.

REFRIGERATING PLANT.

One of the few exhibits representing refrigerating plant was that of John Kirkaldy, of 101, Leadenhall-street, London. It took the form of an insulated cold room built in sections, with 4½in. of silicate cotton insulation covered on both sides with water-proof paper and tongued and grooved matchings. The room was fitted with meat rails and hooks and side battens. The refrigerating plant comprised one ½-ton CO_2 compressor, with a submerged condenser, expansion valve, gauges, and thermometer. Inside the cold room there was a standard brine drum with a special air-cooling and drying coil, and a belt-driven fan to give forced circulation of air in the chamber. There were also a 1-ton and 1½-ton CO_2 compressor, complete with submerged condenser, together with a sectional compressor cut open to show the details of its construction.

STEEL AND IRON CASTINGS.

There were some good examples of fine-grained iron castings on the stand of Thomas Summerson and Sons, Limited, Darlington, under the trade name of "Granfin" cast iron. This material is a product of the electric furnace, and, owing to its exceedingly fine grain, gives tensile results and wearing qualities materially superior to the best qualities of cast iron obtainable from the cupola. The tensile strength is said to range from 18 to 24 tons, while a transverse test on a bar 2in. by 1in. by 36in. gave a deflection of $^7/_{16}$in. at a load of from 36 cwt. to 42 cwt. This firm was also showing a number of steel castings, among which high-pressure steam work was represented by various valves and fittings, from a 14in. turbine stop valve to a 1in. boiler check valve body. Buffer cases, axle-boxes, central bearings, &c., were examples of locomotive and carriage castings, while heavy lorry work was represented by a road wheel and a heavy gear-case. Examples were also shown of high permeability castings for electric work.

BRASS AND COPPER TUBES.

As was only to be expected in a show organised in the Birmingham district, there were some imposing exhibits of brass and copper tubes, rods, &c. These specimens were chiefly collected together on one stand arranged by a joint committee representing the associations which cover these trades. There were all kinds of non-ferrous tubes, rods, both rolled and extruded, mouldings, bushings, chains, &c. Among the many firms represented on this stand there were the Birmingham Battery and Metal Company, Selly Oak, Birmingham; Thomas Bolton and Sons, Oakamoor, North Staffs.; the Broughton Copper Company, Manchester; Grice, Grice and Son, Nile-street, Birmingham; and the Yorkshire Copper Works, Leeds. The Aston Chain and Hook Company, Limited, Erdington, Birmingham, also had a stand on which there were exhibited all kinds of brass goods, including samples of turbine blading, while McKechnie Bros., Limited, Rotton Park-street, Birmingham, also had a separate exhibit, which included brass and bronze rods, sections, stampings, gun-metal ingots, whitmetal ingots, phosphor-bronze ingots, chill cast gun-metal bar, chill cast phosphor-bronze bars, anti-friction metals, brass ingots, yellow metal ingots, and sulphate of copper. This company also had some cored bars, cast in chills, ranging from ¼in. up to 5in. in diameter by up to 48in. long, which were noteworthy on account of the close structure of the metal.

VARIOUS EXHIBITS.

On the stand of the Aerograph Company, Limited, 43, Holborn-viaduct, London, E.C. 1, there were some paint-spraying outfits, one of which was intended for connection with an existing supply of compressed air, while the other was self-contained. In the latter case a small air compressor is driven by a single-cylinder two-stroke petrol engine of 2½ horse-power. The engine, compressor and air receiver are all mounted on a trolley, and the set will supply air for three spraying units.

Bell's United Asbestos Company, Limited, Southwark-street, London, S.E. 1, had a number of steam packings and jointings, including a new type of packing, known as the "Reefer," combining a white metal anti-friction core with asbestos side cushions, besides some "Poilite" building sheets and tiles.

Guest, Keen and Nettlefolds, Limited, Heath-street, Birmingham, had a most imposing stand, comprising three large show cases of screws, nuts and bolts, washers and fastenings; but the range of this company's products is too well known for it to be necessary to enlarge upon them here.

Thomas L. Hale, Limited, Dudley Port, Tipton, Staffs., exhibited a variety of malleable iron castings, machined and in the rough, including Hale's colliery tram buffer caps, which are intended to protect the timber soles of pit tubs, and some ingot moulds, for casting alloys, which are claimed to resist all attack by copper.

James Hendry, Limited, Bridgeton, Glasgow, had a stand on which it exhibited samples of its well-known laminated belting, in sizes ranging up to 16in. wide, and also had some of the belting at work on one of the high-pressure gas compressors used by the Birmingham Gas Department for lighting the Fair buildings.

The W. T. Nicholson and Clipper Company, Limited, King-street, Salford, Manchester, had examples of the "Klincha" type of belt fastener and the "Python" file handles to which we have referred in the past, while Thomas and Bishop, Limited, 37, Tabernacle-street, London, E.C. 2, exhibited their belt dressing, jointing materials, &c.

Nobel Industries, Limited, Buckingham Gate, London, S.W. 1, exhibited principally sporting cartridges, and alongside there was the stand of the allied firm, Necol Industrial Collodions, Limited, on which there were shown all the commodities made at the company's Stowmarket works, including the "Plastic Wood" described in a recent issue of THE ENGINEER.

John and Edwin Wright, Limited, Universe Rope Works, Birmingham, had two stands, one of which was devoted to fibre ropes and yarns, while the other bore specimens of all kinds of steel wire ropes.

Mechanical Gearing and Electrical Transmission.

IN a brief article which appeared in our columns recently, a few leading reasons were given as to why, contrary to suggestions which had previously appeared, it was improbable that turbo-electric propulsion would be adopted for the new British battle-cruisers. There would have been no necessity for calling attention to the accuracy of the views expressed therein, as evidenced by the fact that these ships are now to be fitted with mechanical gearing, were it not for the fact that an electrical contemporary has since attacked both the statements we put forward, and, in general, the attitude of those who, with all the essential facts regarding both systems before them, adhere to the use of mechanical gearing. The apathy towards new developments of which they are accused in one line is magnified into a campaign against electrical propulsion in the next, but whereas we refrained from criticisms of detail, confining the argument to the main comparative features of weight, complication and economy over the full range of power, which are perhaps the principal factors on which marine engineers must necessarily base their choice of warship machinery, it is our contemporary which describes the American system of control—a feature of vital importance in electric systems—as heavy, elaborate and not up to date, and which objects "to the American ships being considered the last thing in electric propulsion." They are, from the "New Mexico" to the "Lexington" class, as we may remind the writer, the only examples of the electrical propulsion of warships, and it is consequently only in "these remarkable vessels"—to use our own phrase—that the real problems of electric propulsion have been encountered in all their diversity and magnitude, for electrical propulsion in a very limited number of small Scandinavian vessels, the performance of which is well known in Baltic circles, is on a trivial scale compared with the United States developments. But lest our contemporary should still consider that the case of electric propulsion has not been fully represented, we will amplify the general statement made in our previous article and which was based, not merely on the extraordinarily ample information published in the United States regarding these vessels—which, by the way, is in strong contrast to the details available of the performances of the Scandinavian ships we have referred to—but also on very first-hand information gathered in the course of an investigation recently made with a view to possible developments in electric transmission, which, as we have just seen, have not materialised.

The United States Navy Department did not adopt electric propulsion without very careful consideration, and when, finally, it was decided upon, the peculiar strategical conditions which that Navy has to meet naturally bore a large share in influencing the choice. Commander S. M. Robinson, U.S.N., who took a leading part from the Navy Department side and has done much excellent work in bringing electric transmission to its present state, has recorded very clearly in an article dealing with the subject, that both as regards weight and efficiency at full power, the advantage lies with mechanical gearing. But these items alone, unless the advantage be overwhelming, may not outweigh other factors, such as economy at very low speeds, if this happens to be a very desirable element, and in the case of the United States more importance is attached to it than in Great Britain, largely owing to the immense distances which separate their bases in the Pacific Ocean. Flexibility of installation and of operation are also considered as being of special advantage, the former in admitting of elaborate subdivision, and the latter in freedom from entire breakdown, owing to the ease with which either generator could operate any shaft motor. The case as between warships which are essentially variable-speed ships, and merchant vessels which are almost entirely constant-speed ships, is vastly different for electric propulsion. Little or no modification in design is entailed with gearing, but the design of a satisfactory form of transmission and control to suit the Service conditions in the former is a very complex matter. It demands very careful study of a wide number of electrical and mechanical problems that do not arise in ordinary generating work at all, and the electrical equipment of a big warship to satisfy the same conditions of ease of control that are found in a geared installation must be, for that very reason, complicated beyond all ordinary electrical work. This particular point is of some interest at the moment, because, apart from the study made of the subject to meet the possible case of an alternative design for the big ships, quite a number of marine electrical inquiries have recently been circulated, and it is obvious that the design of generators, motors and system of working them is a much more difficult proposition than that of selecting mechanical gearing proportions.

Taking first the question of economy as being of primary importance, it is only possible to compare the best which has been accomplished up to date, modified where necessary in the light of such improvements as experience with the latest shows likely to be obtained in sets under construction. Taking, for an example, the same ship with the same boilers and shafting, &c., we have the two stages of heat conversion into power with each form of transmission; one in the turbine, and thence by gearing or electric transmission. Single reduction mechanical gearing of the type generally adopted in Great Britain has, over a wide range of power, an efficiency up to 98.5 per cent., and even down to very low powers the loss does not exceed 3 to 4 per cent. The efficiency of the generators in the New Mexico and Maryland is given officially and by the builders as ranging from 95 per cent. at 10 knots and 96 per cent. at 15 knots, to 97 per cent. at full power, while the motor efficiency is fairly constant at 95.5. The comparative transmission loss between turbine and shaft is—

Percentage of full power	One-tenth	One-half	Full
Generator efficiency	95.0	96.0	97.0
Motor efficiency	95.5	95.5	95.5
Combined efficiency	90.7	91.7	92.6
Efficiency of mechanical gearing	96.0	97.0	98.0
Per cent. superiority of gearing, per cent.	5.3	5.3	5.4

These figures were in use for responsible comparisons of the two systems within the last month or two.

Next, what type of turbine can or is to be adopted? With single reduction gearing, two cylinders in series with two pinions working on a large common gear wheel offer the best results for economy and space occupied, and with two cylinders a very high turbine "K" is being easily and cheaply attained; in fact, one giving a thermal efficiency ratio of 70 per cent.,* or a consumption of 9.6 lb. per shaft horse-power, with steam at 250 lb. gauge pressure and 28.5in. vacuum, which are the guarantee conditions—for dry steam—in the United States ships, is common. With a single cylinder impulse turbine, as in the United States ships under discussion, this high economy is not so easily obtained without considerable increase of size of turbine. The New Mexico's turbo-alternators were some 35ft. long overall—they ran at nearly 2000 revolutions per minute—by 10ft. wide by 12ft. 6in. high. Their thermal efficiency ratio at full power related to the propeller shafts was about 57.8 per cent.* To improve this materially will involve either a considerable lengthening of machine and increase of weight, or else the higher consumption due to the single cylinder impulse design and its low transmission efficiency must be accepted. For much larger units, particularly if the power or the revolutions are increased, we shall expect to see two cylinders, the low-pressure of which must be double flow, as in the Hood and the British destroyers, with consequent considerable increase in weight and overall length. It is quite impossible to dissociate the turbine design from the electric drive. The steam consumption of the New Mexico—with the above transmission loss, of course, included—was as follows:—

Speed, knots.	S.H.P.	Lb. per S.H.P. Guaranteed.	Actual.
10	3,200	15.38	14.35
15	9,200	11.57	11.6
19	20,750	11.32	?. 11.5
21.5	33,000	11.53	11.58

The desired consumptions can be varied according to the design of turbine, so as to give good low power economy with the lowest consumption per shaft horse-power at about 80 per cent. of full power, that at full power rising slightly above this, or the maximum economy can be arranged for full power, in which case the lower power rates will rise somewhat. The former design is adopted for warships, the latter for merchant vessels and the variation in the former is a matter of requirement. In the American ships, with the object of securing as good economy as possible at low powers, the full-power rate was sacrificed.

* In turbine brake horse-power—i.e., without gearing—these values are 71.5 and 62.4 respectively. Both are often exceeded,

The total consumption per hour of the New Mexico is shown in Fig. 1. With the two-cylinder arrangement and mechanical gearing, and a thermal efficiency ratio of 67 per cent. under the same conditions of pressure and vacuum a consumption at full power of 10 lb. per shaft horse-power is now obtained. The total consumption of such a set is also shown, the figures following the straight Willans line as usual. That for the New Mexico falls direct into the origin, but in practice both curves tend to converge slightly below one-tenth full power. The two lines cross at 16.25 knots, or at about one-third of full power, when all four shaft motors are driven from one generator, the other turbo-alternator being cut out, and, like the astern turbines in the geared sets, being kept ready for instant operation, a matter of small moment. The relative gain or loss in steam consumption for the respective main engines is shown in the lines at the foot of the diagram. It is to portion A that so much importance is attached in the United States; portion B is equal to A, and if the vessel spent equal hours at all the different speeds, portion C would represent clear gain for the geared set. The saving at the upper end of the curve goes a long way in nullifying the advantage of 10 knots. Much depends on what importance is attached to the gain at low powers. In the constant speed ship, the superior transmission efficiency of the gearing must inevitably restrict the adoption of any less efficient form of drive, but it is, *par excellence*, in the battle-cruiser

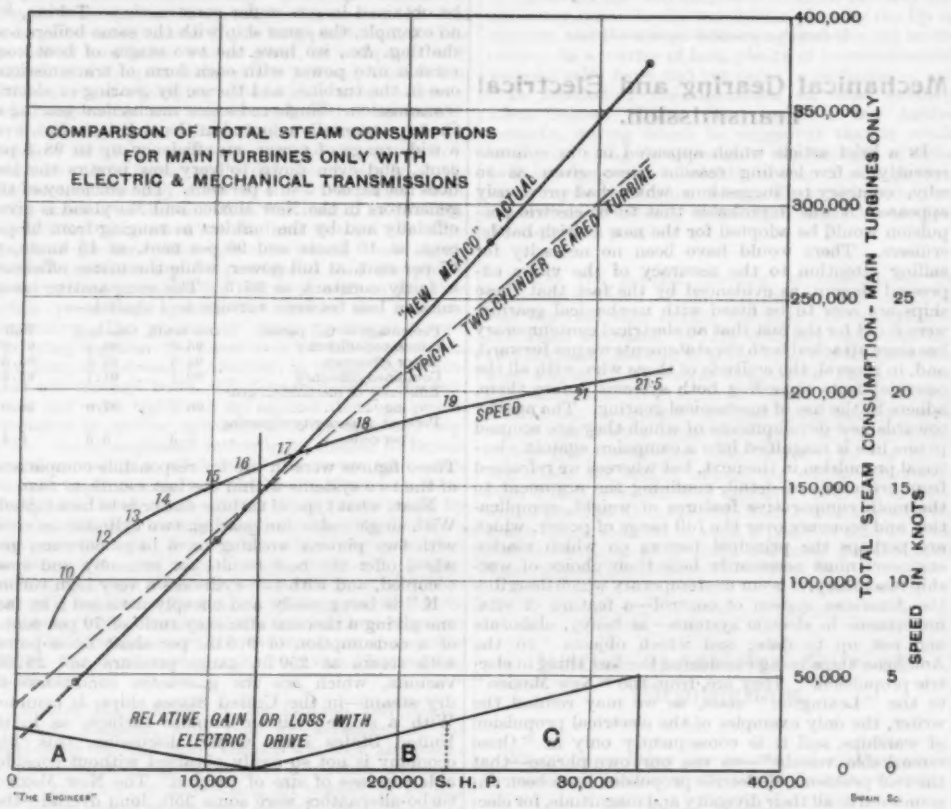


FIG. 1—STEAM CONSUMPTION FOR ELECTRICAL AND MECHANICAL TRANSMISSION IN SHIPS

type that the advantage of electric transmisson is seen. As shown in the New Mexico's speed curve, there is little tangible advantage in economy over the geared set above about 13 knots, and speeds below 16 to 18 knots are very dangerous in wartime—a fact that requires to be remembered, for the advantage then lies with the other type of gearing. In the battle-cruisers of the "Hood" class, which require about 150,000 horse-power for 32 knots, a speed of 20.5 knots is obtained at one-fifth of full power and 16 knots with one-tenth, compared with the 10 knots only in the New Mexico. The Hood can do 14 knots with less than 7 per cent. of her full power. For ocean cruising between 16 and 20 knots—i.e., above submarine speed—electrical transmission does offer this distinct advantage in economy; whether the much greater weight and complexity offset this particular advantage is quite another matter. For one nation it may, solely for geographical reasons; for another, with ample coaling stations and no reason for cruising in mid-Pacific, and with several years recent experience of the necessity of the use of high speeds in wartime, what may be advantageous to others, may on balance be a positive disadvantage to ourselves.

As to cost—a very formidable item at the present time—can there be any doubt whatever as to the much lower first cost of the geared set for the ships we spoke of on September 9th? The contract for the New Mexico's machinery was placed, in 1915, with the General Electric Company, of Schenectady, whose experience of electrical machinery is very wide, and whose consulting engineer, Mr. W. L. Emmett, was advocating electric propulsion as long ago as 1908, before the geared turbine was tried in England. It consisted of—

Two turbo-alternator units, complete with throttle and governor valves.
Four main propelling motors.
Switchboard and control gear, panels, instruments, insulators, &c., and all cables.
Two main motor-driven circulating pumps.
Two main motor-driven air pumps.
Two main motor-driven hotwell pumps.
Four main motor-driven oil pumps.
Two motor-driven oil coolers and tanks.
Motor-driven blowers for ventilating main motors.
Spare parts for the above apparatus.

The total estimated weight of this installation was 700 tons; it actually proved to be 590 tons. The contract price for the above is stated by the General Electric Company to have been 431,000 dollars, or, say, £86,500 at par. It is very difficult to compare costs and prices in different countries; but as regards weight, four sets of turbines and gearing with the corresponding auxiliaries would weigh about 470 tons. It was on these broad lines of economy, complication and weight that our article suggested that, for British purposes, electric transmission would prove less suitable than gearing. We may go a little further.

Our electrical contemporary roundly condemned our desire to know more about the performance of these electrically propelled ships, and cites the mass of information published in America. But these data deal almost entirely with material and not performance in service, which is precisely what is needed. Little or nothing has been published about the Swedish sets, except the comparison between the ss. Mjölner and a sister ship, and we refrained from quoting some of the difficulties which have been experienced in the smaller vessels because they bore in no way on the subject we were discussing. One of the problems in electrical propulsion on any large scale lies in the adequate ventilation of motors and generators. These cannot be ventilated directly with salt-impregnated air, and in the American ships, which require two fans to each motor and generator—some 140 horse-power which does not figure in the above consumptions—special arrangements are necessary for drying the air before it is used. This air supply to the motors might easily be interfered with by damage exterior to the engine-room. Again, the entire control of the whole propelling machinery is centred in the switchboard in the central engine-room, as it must be centred in any electric ship. There is no such concentration of control, no such wholesale reliance on immunity from accident on one item, failure in which means utter breakdown, to be found in any other department. Guns can be fought or the ship can be steered if director tower or conning tower be put out of action. The greatest care has naturally been taken in the design to prevent accident from internal and external causes, but the possibility of all shafts being stopped through a single fault is peculiar to electric transmission, and does not arise in geared installations. The prospect of a bad short circuit in an engine-room is not pleasant to contemplate. The effect of the inevitable condensation of vapour is a further point on which experience requires to be gained. Yet we presume that if we pursue this subject we shall incur the risk of being accused of running down electric propulsion, which is far from our intention. We know that special arrangements were made in the American vessels to guard the cables against this; it is only one of very many problems that require solution before electric transmission can be adopted with the same degree of certainty as the geared turbine is. And the principal one among these for merchant steamers is the question of relative economy and first cost. A secondary one is that of control, and this cannot satisfactorily be accomplished by means other than electrical—for instance, by the use of a clutch—for the reason that the propeller is then not under continuous control as it is in the American ships, or with gearing, even if a satisfactory clutch could be devised.

The extent to which electric propulsion has been adopted, except in the United States Navy, is very limited. In addition to the New Mexico and her sister ships California and Tennessee, the four battleships of the "Maryland" class, of about 33,000 shaft horse-power, the six of the "South Dakota" type, of 60,000 shaft horse-power, and all six of the "Lexington" class of battle-cruiser, of 180,000 shaft horse-power, all with four shafts, are all fitted with this form of transmission, the contractors for the machinery being either the General Electric Company, of Schenectady, or the Westinghouse Company, of Pittsburg. We cannot altogether acquit our contemporary of denying indisputable facts when it repudiates any suggestion that these installations represent the latest practice in electrical propulsion if only because there is nothing else to compare with them. The United States authorities very naturally compare the performance of their own vessels, and the superior economy of the New Mexico over her sister ship Pennsylvania, which is fitted with direct connected main turbines and geared cruising turbines for use up to 15 knots, is of the order of 20 per cent. for speeds of 19 knots upwards and about 30 per cent. at 15 knots. At lower speeds, partly because these geared cruising vessels exhibit very good economy at very low powers, the fuel saving is very small. Compared with the Mississippi fitted with direct drive Curtis turbines and geared cruising turbines, there was a saving in weight of over 200 tons in the New Mexico. But these comparisons are with ships which were laid down in 1914–15, and not with all-geared vessels, of which there are no big ship examples in the United States Navy, and which in the British service also show superior economies of 20 to 25 per cent. over the last direct driving sets fitted. It is impossible not to admire the work of the General Electric Company in particular, and the ability displayed in solving the many and difficult problems involved in applying efficient variable-speed motors to propeller shafts. A vast amount of care and trouble has been devoted to these designs, and the case for electric propulsion is less likely to be aided by criticism of them by exuberant enthusiasts than by their offering reasonable proof that any other form is likely to meet the drastic requirements of efficiency and reliable operation which are now available in other types of transmission.

Institute of Metals.

No. III.*

The second paper taken on Wednesday, March 8th, was one on "The Internal Mechanism of Cold Work and Re-crystallisation in Cupro-nickel," by Mr. Frank Adcock.

Cold Work and Re-crystallisation in Cupro-nickel.

The problem was attacked in a conventional manner, by observing under the microscope the polished and etched surfaces of metal specimens which had been subjected to various degrees of cold working and heat treatment. Cast cupro-nickel, annealed until homogeneous, was selected as a suitable basic material, since good etchings were obtainable with citric acid attack. The metal was able to withstand a considerable amount of cold working and yet was sufficiently hard to permit of rapid preparation for micro-examination. Material which had been subjected to reductions of 50 per cent. and 88 per cent. by cold working was examined and observations were made on the nature and direction of certain strain planes which passed through most of the crystal grains of the distorted metal. The possibility of a gradual distortion of the crystal structure apart from "slip" was also dealt with, and reference was made to the cavities which appeared on etching the worked material. In order to follow the process of re-crystallisation, cold-worked specimens which had been annealed for fixed periods of time at progressively higher temperatures were examined microscopically. It was noticed that the first effect of annealing was the accentuation of the "strain" markings previously visible in the worked specimens, followed at higher annealing temperatures by the appearance of new crystal grains which were

* No. II. appeared March 17th.

generally associated with the previously mentioned "strain" markings and occasionally with old crystal grain boundaries. New grains which appeared on the sites of the "strain" lines were frequently elongated in the direction of those lines, and not necessarily in the direction of rolling, and, further, the crystalline orientations of such grains were apparently not related to that of the old grain in which they were born. A theory was put forward as an attempt to explain some of the experimental facts which were not altogether in agreement with the usually accepted views on the subject. The hardness of the cold-worked metal as indicated by the Brinell test did not begin to fall appreciably until the annealing temperature employed was such that new crystal grains were readily discernible under the microscope.

Mr. J. R. Johnson congratulated the author on a very beautiful piece of work and on the discovery of an alloy which was very suitable for the study of re-crystallisation in its various stages.

Miss C. F. Elam welcomed the paper as supporting all previous investigations which had shown that re-crystallisation after work was always associated with an interruption in the crystalline structure. One extremely interesting point raised in the paper was with regard to the bending of crystal structures. The author had come to the conclusion that the crystal orientation was altered by bending, but later observations, of which he mentioned several, did not confirm that view. The question could be tested on fairly large crystals by examining with oblique illumination, but she did not know whether the crystals were large enough to permit such a test. Nothing showed up the difference of orientation so well as oblique illumination; by rotating the specimen very small differences were at once observed. She had been so exceedingly interested in the experimental part of the paper that she was sorry the author had attempted an explanation based on any sort of theory. Information of the kind contained in the paper was very much more valuable than any amount of speculation at the present time.

Dr. W. Rosenhain, on the contrary, thought that the time had come for theorising on such matters. The non-committal attitude of merely collecting facts was useless from a scientific point of view; they had to try and understand, and it was far better to put forward a hypothesis even if ultimately it was proved to be incorrect, than merely to announce the simple dry facts. The actual facts which the author had related were extremely interesting, and were borne out very strikingly by a series of experiments carried out in the National Physical Laboratory by his colleague, Mr. Marriott, some little time ago with a different alloy, an alloy which was prepared for electrical purposes containing 9 to 11 per cent. of manganese and about 3 per cent. of nickel.

The next contribution was that by Major C. J. Smithells on "The Effect of Impurities on Re-crystallisation and Grain Growth."

Re-crystallisation and Grain Growth.

The research described in the paper was undertaken to determine the effect of small quantities of impurities in tungsten on the structure developed on annealing. Tungsten wires were prepared containing accurately known quantities of thoria, alumina, silica, lime, and the alkali metal oxides, in various proportions. The progressive changes in crystal structure on annealing at 2500 deg. were followed in each case, and the distribution of the impurities in the metal determined. It was found that the refractory oxides, which ultimately segregated in the grain boundaries, exerted a definite resistance to grain growth, depending upon the nature and amount of oxide present. The alkali metal oxides alone had no influence upon grain growth. An entirely new type of exaggerated growth was, however, found to take place on annealing tungsten containing a few tenths per cent. of both a refractory oxide and an alkali metal oxide. Single crystals occupying the entire cross-section of the wire, and three hundred times as long as their diameter, were formed on annealing for a fraction of a minute. The authors advanced a hypothesis based on the idea that crystal growth and re-crystallisation in metals depends on a difference in vapour pressure between neighbouring crystal grains. On this hypothesis the new type of exaggerated grain growth was, they held, satisfactorily explained. This hypothesis, they stated, explained the known phenomena in relation to the effect of strain, grain size, and temperature in regulating re-crystallisation and grain growth on annealing.

Dr. Carpenter thought that note should be taken of the fact that the paper was the first which had been received from the research laboratories of the General Electric Company. The paper recorded a very interesting case of rapid crystal growth under very special conditions, and he would like to ask the author how he measured the temperatures that he quoted; they were extremely high temperatures, at which, no doubt, the vapour pressure was a very big factor. Another special feature of the case was that the metal was admittedly homogeneous to begin with, consisting of powder which was compressed and swaged and then drawn down to wire, and on the basis of that fact the author put forward a hypothesis that the growth of the crystals was caused, in the first place, by the existence of sufficient vapour pressure to produce a distortion, and, secondly, by the differences which were such that vapour passed from the crystals of higher to those of lower vapour pressure. He thought it might be admitted that as far as the special case which the author had put forward was concerned, that might be regarded as a plausible explanation. The author had submitted no evidence at all in favour of his hypothesis. First of all, it depended on the existence of sufficient vapour pressure for there to be distortion at all. Running down through copper, lead, tin, aluminium, iron, chromium, magnesium and manganese, it appeared that there would be no measurable vapour pressure at the temperatures at which alloys were ordinarily worked and studied. To sum up, he held, first of all, that there was very grave doubt as to the existence of a sufficient vapour pressure at all to account for the general application of the hypothesis to metals, but that even if it were true there were four assumptions which the author made to which very great objection could be taken.

Major Smithells, in reply, said that the whole hypothesis was put forward to try and account for the effects of crystal growth which were still not explained by any hypothesis. Professor Carpenter had taken him perhaps too literally when he spoke of vapour pressure. In spite of the criticisms which had been made and the other cases which had been cited, the majority of workers had undoubtedly found that large grains did absorb small grains.

A paper was then presented by Mr. H. Moore and Mr. S. Beckinsale on "Further Studies in Season Cracking and its Prevention."

Season Cracking and its Prevention.

The work reported in this paper was carried out with a view to the application to Admiralty condenser tubes of the low-temperature annealing previously recommended by the authors for the removal of internal stress in brass and the consequent prevention of season cracking. Split tubes showed the usual characteristics of brass which had failed by season cracking. The properties of condenser tubes of eight different makes and also of a quantity of tube purposely made by methods inducing a state of high internal stress were determined before and after annealing at temperatures in the range 250 deg. to 325 deg. Cent. By numerous annealing experiments on flat strips of condenser tube brass elastically bent to an arc of a circle and thus initially stressed to a known amount the effects of (1) initial hardness, (2) initial stress, (3) time, and (4) temperature, on the reduction of initial stress by low-temperature annealing were separately determined quantitatively. It was found that:—(1) The rate of reduction of stress at the lower temperatures was fairly rapid at first, but became slow when the stress had been considerably reduced; (2) As the temperature was raised the rate of reduction of stress increased; (3) The higher the initial stress, the higher was the remaining stress after a given treatment, in condenser tube brass of the same hardness; (4) The higher the hardness of the brass, the lower was the remaining stress after a given treatment and for a given initial stress. The elastic limit and yield point of cold-worked condenser tube brass were found to be raised by treatments which would greatly reduce initial stress, a temperature of 250 deg. to 275 deg. Cent. being the most effective in restoring elasticity in the overstrained material. The Brinell hardness of condenser tubes is commonly between 140 and 160, having been raised considerably by the final cold drawing. Treatment at 280 deg. to 300 deg. Cent. for thirty minutes is recommended for condenser tubes. This treatment reduces any initial stress present to a safe limit without injury to and in some cases with marked improvement in the strength of the tube.

Mr. Rolfe agreed that there was evidence to show that splitting might occur in condenser tubes, and in so far as it was a serious problem in practice, the paper presented a simple and effective method of prevention. The only point about which he thought that doubt existed was as to the liability of tubes to split in service. There was a previous Admiralty reference which the authors apparently had overlooked. It was in Admiral Sir Henry Oram's presidential address to the Institute in 1914, when the developments and changes in the Admiralty specification were treated in a very detailed manner. The figures then given for failures caused by splitting in service were for two different years. In 1908, when there were 2½ million condenser tubes in service in the British fleet at sea, the failures caused by splitting were 21 per annum, the proportion per annum being 1 in 114,000. In the year 1913, when the number of tubes had increased to 3,800,000, there were 16 failures, or 1 in 237,000. Admiral Oram's argument was that beyond a certain point further tests, experiments and additional precautions both in treatment when at work and during the manufacture became so expensive as to be not worth the cost involved. His firm had made condensers for over forty years, and it had not had reported to it a single case in which any tube had split in service. He had himself seen at different times many hundreds of tubes which had been in service, but had never seen a split tube. For the purpose of investigating this problem he drew three dozen tubes from different sources out of his stores, and subjected them for a period of six weeks to immersion in two different solutions of ammonia and mercurous nitrate, without finding a single crack. The authors could only refer to two cases of split tubes in their own experience. He did not think on the available evidence that the systematic annealing of all tubes could be demonstrated to be worth while. Further evidence was needed at the present time that splitting was a sufficiently serious trouble to warrant applying to all condenser tubes a process which could only increase their cost.

Admiral Sir George Goodwin said that occasionally there was cracking in Admiralty tubes. It had been said that twenty-one tubes out of some millions gave out in one year through splitting. Those tubes had a knack of distributing themselves very widely, and at a guess he should say that those twenty-one tubes were distributed among twenty-one ships, and from that point of view the extent of the nuisance could be understood. As Sir Henry Oram had said some years ago, the number of condenser tubes that gave out from all causes in the Navy compared with the number of tubes fitted was extremely small. It was the same to-day. The majority of the ships went through their service without any trouble whatever from the cracking of condenser tubes. There had just been an epidemic of condenser tube corrosion on the China station and in home waters, and a considerable number of tubes had split in store. The tubes in the condensers of the ships of the China squadron were to be renewed by taking out of store tubes which seemed to be liable to season cracking and perhaps subjecting them to the treatment which had been prescribed by Dr. Bengough and Mr. Moore, giving them a coating of oxide and subjecting them to low-temperature annealing. He thought that would be a very practical test, and in due course the results of it would be given to the Institute. As there was some disagreement between Dr. Bengough and Mr. Moore on the question of temperature of annealing and oxidation, it would be an advantage if they would consult together and advise what temperature should be used before the Admiralty carried out its experiment. He would also like to know whether any additional precautions would be necessary in dealing with tubes 15ft. long.

Mr. Moore, in replying to the discussion, thought that the fact that failures, although comparatively few in number, might cause serious trouble by reason of the number of ships involved, was a justification for the expense which might be incurred in special treatment. He was not yet in a position to report the result of the tests which were in progress, but he was able to state that the strength of the tubes was in many cases improved by the treatment recommended. The trials which Sir George Goodwin was arranging to have carried out by the Admiralty should prove of the utmost value.

Five papers were on the agenda for the second and concluding day's proceedings of the annual meeting. Mr. Leonard Sumner (President) occupied the chair.

The first paper taken was one by Professor C. A. Edwards and Mr. A. J. Murphy, "The Rate of Combination of Copper and Phosphorus at Various Temperatures."

Copper and Phosphorus.

The object of the authors' research was to determine the temperature at which rapid combination between copper and phosphorus commences, and to trace the effect of time on the progress of the reaction velocity. The rate at which solid copper combines with phosphorus vapour at temperatures up to 700 deg. Cent. has been determined. When using ¼in. diameter copper rod, it was found that the maximum rate of increase of phosphorisation for a given rise of temperature occurred at 640 deg. Cent. If this temperature be used, the authors consider that the chief advantages are (1) a quick but safe rate of phosphorisation at a low economic temperature; (2) the operation can be controlled so as to prevent the formation of any liquid; (3) it is impossible to obtain an alloy containing more than the percentage of phosphorus which is required commercially. It ought to be an easy matter, it is contended, to evolve a continuous process which would be free from danger and give little or no loss of phosphorus.

Mr. J. R. Johnson, who has himself done some work on the phosphorisation of molten copper by the addition of solid phosphorus, said that the subject was more important than was generally believed. The facility with which copper which would otherwise be unsound could be made perfectly sound, or copper which was brittle by reason of excessive oxygen or cuprous oxide could be rendered malleable, by the addition of a judicious but very small proportion of phosphor-copper was most extraordinary. Hence any work such as that which had been so ably carried on by the authors, which would give a cheaper or a more reliable method of producing phosphor-copper, was very welcome indeed.

Mr. Charles Billington said he had been making phosphor-bronze for the last twenty years on a commercial scale. He made phosphor-bronze containing from 10 per cent. to 16 per cent. phosphorus. With regard to the commercial aspect, he thought at the present moment the price of phosphor-copper was at rock bottom; in fact, it was on a pre-war basis, and owing to the risk and trouble there was in making it, he failed to see much hope of cheapening its production. There was no doubt it was one of the finest de-oxidisers for non-ferrous alloys. It was a mistake,

however, to make phosphor-copper containing as much as 1 to 2 per cent. of phosphorus in the finished product. That was going too far, because the effect of the phosphorus on the copper was not to harden it in the usual sense of the word but to make it brittle. If tin was used up to about 10 or 12 per cent., and then 1 or 2 per cent. of phosphorus were added, a brittle and not a hard metal was obtained. He himself thought that tin was the metal that should be used for hardening, and phosphorus simply used as a de-oxidiser to obtain a more homogeneous alloy.

Professor F. C. Thompson raised a point of some interest in connection with the diagram shown on page 29 of the paper. A dotted line had been put in to show the solubility in the solid state. He desired to ask the authors whether the second part of the diagram from the compound Cu_3P was the liquidus or the solidus, or whether it was merely the temperature at which appreciable dissociation of the solid took place. The evidence for the compound was not good, and evidently the authors realised that fact, since they had queried that point. Apparently the only compound which had any definite existence, as far as was known at the present time, was the Cu_3P. For a given temperature the constant, as the authors had pointed out, varied appreciably with time. Especially was that the case at 640 deg., where it varied from .0016 to .0010, and, at the higher temperature, the variation was greater still. The point the authors made, that the more simple expressions were not sufficient when dealing with the more complicated reactions that the metallographer had to consider, was a very important one indeed, and one on which they ought to be sincerely congratulated. Metallography was inevitably becoming a mathematical subject, and so long as implicit reliance was placed on relations which had been obtained by the physical chemist for other systems, the danger of going astray was great.

Professor C. A. Edwards, in reply, said that the authors' object from the practical point of view had been to try and fix a temperature which would give the most economical working coupled with the minimum possible danger to workmen and minimum loss.

Dr. Rosenhain then presented a paper entitled "Some Cases of Failure in Aluminium Alloys," of which an abstract follows.

Failures in Aluminium Alloys.

The note deals with cases of failure from growth or distortion occurring in what are frequently described as aluminium alloys. The author has found that the alloys which undergo distortion and disintegration of this kind usually consist mainly of zinc, and are not properly described as aluminium alloys, the latter term being rightly reserved for materials consisting mainly of aluminium. Two cases are described in detail, one relating to an electricity meter casing which contained 81 per cent. of zinc, and the other to a name-plate used by Reavell and Co., Limited, of Ipswich, which contained 54 per cent. of zinc. In both cases distortion, growth and disintegration had occurred. It has been shown in a previous paper by the author (with Haughton and Bingham) that alloys consisting largely of zinc and also containing aluminium and copper, are unstable at the ordinary temperatures, and are liable to changes of dimension and disintegration. The failure of castings of the kind described is, therefore, not surprising. Careful distinction should, however, be made between alloys of this kind consisting largely of zinc and true light alloys of aluminium. The latter, if properly compounded and prepared, may be regarded as sound engineering materials free from any risk of serious growth or disintegration, and it would be unfortunate if their use were in any way hampered by unfavourable experiences with alloys containing a large amount of zinc.

Dr. Hanson, while in entire agreement with the author, did not think it was necessary to condemn the zinc alloys absolutely. Although they did, under certain circumstances, disintegrate, he thought enough was now known about them—as he hoped to be able to demonstrate later on, in the paper to be read by Miss Gayler and himself—to render it possible to heat treat them in such a way as would avoid such disintegration. That disintegration was due to spontaneous changes which took place in the alloy after it had been cast, and he was sure that in many cases, if metallurgists understood those changes, they would be able to submit the alloys to such treatment as would enable the changes to take place without harmful effects in the finished article.

Professor T. Turner thought Dr. Rosenhain had done good service in drawing attention to the fact that alloys which were called aluminium alloys were often not so. If the system of nomenclature recommended by the Institute were adopted they would not be called aluminium alloys at all, but aluminium-zinc alloys, and if that system were adopted it would do away with some of the reproach which had undeservedly fallen upon aluminium.

Mr. Charles Billington asked whether the author did not think the failure of the metal was caused by the small percentage of tin present.

Dr. Rosenhain said that the answer to the last question was in the negative, because experimentally made alloys, quite free from tin, underwent the changes. The tin was not of advantage to the alloy, but it had nothing at all to do with the particular phenomenon under consideration. With regard to the question of heat treatment, no doubt that was possible, but the alloys under consideration were used mainly because they were extremely cheap and very easy to cast. If they had to be heat treated afterwards, the user might just as well employ a rather more expensive metal that did not need that treatment. None the less, the fact that heat treatment was possible was worth remembering, and it might, under certain conditions, be of great value.

The Future of the Port of Shanghai.

The following official statement, relative to the meeting of international engineers which took place in Shanghai last October, has been sent to us by the Whangpoo Conservancy Board :—

The Conservancy Board's investigation into the possibilities for the future development of the Shanghai harbour, which has been in progress since early in 1919, includes the formation of a special committee of consulting engineers to criticise and decide upon the suitability of the projects which have been developed during the investigation. The investigation includes a technical-economical consideration of all the technical accommodation and terminal (wharf, pier and cargo-handling) facilities of Shanghai.

The actual work of the Commission was to consider and report on the further harbour development possibilities at Shanghai, (*a*) with approaches to and limit of draught in the harbour remaining as at present, 28–30ft.; (*b*) for the probable maximum draught of ships on the Pacific.

It was specified in the original programme that for the formation of the committee one member should be chosen from amongst leading shipping nations (including China) at Shanghai as represented on the Whangpoo Conservancy Consultative Board, the Engineer-in-Chief of the Conservancy Board to be an *ex-officio* member. Nominations were made as follows :—

Nominated by the American member of the Whangpoo Conservancy Consultative Board : Major-General W. M. Black, formerly Chief of the U.S.A. Engineers (Retired), consulting engineer of the firm of Black, McKenney and Stewart, Washington, M. Am. Soc. C.E.

Nominated by the British member of the Whangpoo Conservancy Consultative Board : F. Palmer, C.I.E., M. Inst. C.E., consulting engineer of the firm of Rendal, Palmer and Tritton, London, formerly Engineer-in-Chief, Port of Calcutta, and Consulting Engineer to the Port of London Authority, of which he was Chief Engineer from 1909–1913.

Nominated by the Chinese member of the Whangpoo Conservancy Consultative Board : P. G. Hornell, C.E., M. Swed. C.E., consulting engineer of the firm of Aktiebolaget Vattenbyggnadsbyran (Hydraulic Engineering Bureau), Stockholm, consulted by the ports of Gothenburg, Stockholm, &c.

Nominated by the Dutch member of the Whangpoo Conservancy Consultative Board : P. Ott de Vries, C.E., until recently Head of Department of Public Works, Netherlands India, now retired.

Nominated by the French member of the Whangpoo Conservancy Consultative Board : L. Perrier, Ingénieur-en-Chef du Corps des Ponts et Chausées, Paris, for twenty years engineer on the Suez Canal.

Nominated by the Japanese member of the Whangpoo Conservancy Consultative Board : Dr. Isamu Hiroi, C.E., elected Dr. Engineer (Tokyo), formerly Engineer-in-Chief, Hakodate and Otara Harbour Works, and Professor, Tokyo University ; Consulting Engineer to Government Railways ; member of a Harbour Investigation Committee, Tokyo, M. Am. Soc. C.E.

Ex-officio member appointed by the Conservancy Board : H. von Heidenstam, C.E., Capt., Royal Swedish Corps of Engineers, M. Inst. C.E., M. Am. Soc. C.E., Engineer-in-Chief of the Whangpoo Conservancy Board.

The Commission's Task.

The Commission met in Shanghai on October 15th and stayed about six weeks. The task before it was of great difficulty, as it had carefully to weigh a number of conflicting technical and economical considerations. Amongst the principal questions were :—

(1) The possibility of improving the Yangtze estuary bar.

(2) The alternative question of a Hangchow Bay approach.

(3) The provision of improved berthing accommodation and general port improvement, even with approaches remaining as at present.

The schemes submitted to this Committee included a general consideration of all conceivable possibilities, but more especially various suggestions for dredging or training the great Yangtze Bar, known as the Fairy Flats ; for a *port de vitesse* on the Hangchow Bay as an alternative to an improved Yangtze approach ; and for lay-outs for first-class wharf accommodation in the Huangpu and elsewhere. Very important and illuminating studies were made of the economic side of the whole questions.

In order to provide proper data for these projects a special department was organised, surveys were made on land and water over all the areas involved, hydrological and geological studies were made, and expert engineers in the homelands were consulted on detailed problems. The series of special reports on data were issued as follows :—

Shanghai Harbour Investigation Reports, 1920–1921.

Series I.—General Data.

1. Geology of the Yangtze Estuary.
2. Hydrological Data for the Yangtze Estuary up to 1918.
3. The Port of Shanghai.
4. The Improvement of the Huangpu River (1918).
5. The Hydrology of the Hangchow Bay.
6. Maps :

(*a*) Lower Whangpu and Woosung Anchorage.
(*b*) Whangpu from Seven Mile Reach to Black Point.
(*c*) General Map of the District around and Approaches to Shanghai.
(*d*) Chinese Maritime Customs Chart of Yangtze Estuary, 1920, published by the Maritime Customs.
(*e*) Chinese Maritime Customs Chart of the Hangchow Bay, published by the Maritime Customs.

7. Reports to the Engineer-in-Chief on Special Investigations.

Series II.—Projects :

1. 1917 Memorandum on a *Port de Vitesse* on the Hangchow Bay.
2. General Report for the Committee of Consulting Engineers (not for sale).

A number of tentative projects and reports on special data were supplied to the Committee in addition to the above.

The Committee's Report.

The Committee's report has just been published. It includes among its recommendations a revision of the agreement as to the Whangpoo Conservancy between the Chinese Government and the foreign Powers so as to provide a proper harbour authority, the dredging by very powerful appliances of the Yangtze Bar, and the provision of a mail steamer wharf near the mouth of the Whangpoo and a commercial wharf and dock below Shanghai. Immediate expenditure of some eleven million taels is recommended and the general lines are laid down for future development. The report has been forwarded to the Chinese Government for its consideration.

THE MOTOR TANKER NARRAGANSETT.

On Monday last the members of the Institution of Automobile Engineers accepted the invitation of the Anglo-American Oil Company, Limited, to visit its Purfleet fuel storage installation and to inspect the motor oil tank ship Narragansett, and we had the pleasure of being present on the occasion. The Narragansett, which was built and engined by Vickers Limited, of Barrow-in-Furness, ran her trials in May, 1920, which trials were described in our issue of May 14th of that year. Since that time the vessel has been engaged practically continuously in the Atlantic oil-carrying trade. The results of her voyages, several of which have been made in heavy weather, have, we are informed, demonstrated her reliability and economy of operation. Under present conditions, so we understand, a motor vessel such as the Narragansett can carry cargo in Atlantic trade and show an overall saving of about 8 per cent. as compared with an oil-burning steamer of similar capacity.

Having regard to the fact that a motor vessel carrying oil and spirit cargoes runs much less risk of fire than does a steamship, the company hopes that the Port of London Authority will ultimately allow such vessels to discharge the whole of their cargoes directly into the company's tanks at Purfleet instead of insisting that the spirit shall be transferred first of all into lighters at Thames-mouth, as it now does. Such direct discharge of cargoes would naturally reduce the overall handling costs, and in this connection the experience which will be obtained in the working of the new oil dock at Stanhope Point in the Eastham Section of the Manchester Ship Canal should provide some useful information. This dock, which is to be opened about the end of the present month, was, we may say, referred to in our last issue. It is of interest to note that on occasion the company's vessels carry a cargo consisting of over eleven different grades of oil and spirit, in addition to supplies of paraffin wax and oil stoves.

The machinery of the Narragansett will be familiar to our readers from our description of the vessel already mentioned and also the account of the Vickers solid injection marine engine given in our issue of July 15th. During the time that the vessel has been running the engines have, so it is stated, been in every way successful. Practically no repairs of importance have been necessary since she was commissioned, while the fuel spraying valves, as well as both the inlet and exhaust valves have required little attention and have given no trouble.

INSTITUTION OF ELECTRICAL ENGINEERS.

SUMMER MEETING IN SCOTLAND.

The summer meeting of the Institution of Electrical Engineers will be held at the Scottish Centre from May 30th to June 2nd next. Ladies are invited to take part in the meeting. In the morning of Tuesday, May 30th, a visit will be paid to the Dalmarnock generating station, members having previously listened to a paper on that station to be read at the Royal Technical College by Mr. R. B. Mitchell. In the afternoon there will be visits to John Brown and Co., Limited, Shipyard, Clydebank, the Clyde Mill power station of the Clyde Valley Electrical Power Company, and to other works, and a circular excursion by road to some of the Glasgow Corporation reservoirs. In the evening there will be a reception and dance at the Municipal Buildings, at the invitation of the Corporation of Glasgow. On the Wednesday morning a paper will be read at Glasgow University by Professor Magnus Maclean on "The Hydro-electric Resources of the Scottish Highlands." In the afternoon members are, at the invitation of Messrs. Babcock and Wilcox, to visit that company's works at Renfrew, and to make an afternoon and evening steamer excursion on the Firth of Clyde. On the Thursday members will leave Glasgow for Fort William at 10.30 a.m. by special train. A break of journey will be made at Tulloch Station to view source of supply of the Lochaber water-power scheme. Fort William will be reached in the evening. On the morning of Friday, June 2nd, there will be a special steamer trip to Kinlochleven, which will be reached about mid-day, and a visit to the British Aluminium Company's hydro-electric installation. In the afternoon the party will travel by steamer to Oban, where the meeting will terminate.

A Seven-Day Journal.

Engineering and Shipbuilding Disputes.

IT is not only optimists, but even those who have been inclined to take a serious view of the engineering crisis, who find in the latest news grounds for hope that a peaceful solution may be reached, perhaps even within a few days. Mediators are again at work, and there is a disposition to accept Sir Allan Smith's statement that if the union representatives would admit the principle of undisputed managerial control by employers as a basis for fresh negotiations on matters of detail, an agreement might be reached. It was good news, too, that after reporting the result of a preliminary meeting with Sir Allan and Mr. James Brown, the secretary of the Employers' Federation, the union leaders have received authority to continue these conversations. It is understood that unless negotiations are again broken off, the lock-out notices may be suspended for a further short period. In the shipbuilding industry notice has been given by the Employers' Federation of a cut of 10s. 6d. per week from March 29th, and a further reduction of 6s. per week a month later. It is therefore a question for the workers to accept this reduction or refuse to work. The attitude of employers is that unless wages are reduced, there is a grave fear of the industry coming to a standstill.

Shoreham's Mystery Tower.

AFTER persistent representations by the local authorities to the Admiralty in connection with the obstruction to navigation caused by the continued presence in Shoreham Harbour of one of the two mystery towers constructed during the war period, the Admiralty has decided to break up that which remains at Shoreham. The second tower was, it will be recalled, removed from the harbour in the autumn of 1920 and placed in position off Portsmouth for use as a lightship. Although the precise object for which the towers were built was never definitely stated, it is generally understood that they were intended to form links in a chain of floating forts of similar design which were to be used as a Channel barrage if the war had been prolonged. The Shoreham Harbour Trustees have entered into an arrangement by which a considerable quantity of the concrete of which the tower is constructed is to be deposited on the east beach, which is in need of strengthening.

Warship Building and Unemployment.

THE cutting down of naval expenditure has, altogether apart from the general depression in the shipbuilding industry, made a considerable increase in the number of unemployed in the warship building centres. As a result of conferences of representatives of the various districts affected, a deputation from Glasgow, Newcastle, Sheffield, Barrow and the North-East Coast waited on Lord Lee and Sir Robert Horne this week to discuss what steps could be taken to alleviate the distress which has arisen. It was suggested that as the present position has been brought about by Government action, the State should come to the aid of local authorities in dealing with a situation with which the latter are not in a position to cope. The scheme suggested was that contracts for the two new capital ships should be given out as early as possible and work in connection therewith, including the gun mountings, put in hand, that the re-conditioning of existing warships should be expedited, that colonial Governments raising loans in Great Britain for public works should be asked to place contracts in this country, and the Department of Overseas Trade invited to encourage the construction of railway and other works in the British Dominions and Protectorates and to place orders for material in Great Britain. The Government representatives were unable to do more than to give the stereotyped reply that sympathetic consideration should be given to these proposals and a more definite statement made after consultation with the departments concerned.

Future of the Air Force.

ALTHOUGH the Government has refused for the time being to set up a Ministry of Defence, in which the Navy, Army and Air Forces would be represented and their functions co-ordinated, there is satisfaction in aviation circles at the fact that the claims of the Navy to absorb the naval air force and of the Army to take under its wing the military air force have been refused. Mr. Chamberlain announced that the Standing Committee of the Committee of Imperial Defence had recommended that the Air Force must be autonomous in matters of administration and education, and that in the case of the defence against air raids the Navy and Army must play a secondary *rôle*. It is conceded that in the case of military operations by land or in operations by sea the Air Force must be in strict subordination to the Admiral or General in supreme command, but that in all other cases the relations between the Air Force and the other Services should be regarded as a matter of co-operation rather than of strict subordination. Rear-Admiral Sir Reginald Hall insisted that the naval air forces should be put under the control of the Navy, as there was no place at sea for a separate air service. The Government decided to appoint a Committee to examine the whole question, but it was made clear that the proposed absorption of the Air Force into the other Services would be regarded as a retrograde step.

France and Submarines.

A CONTROVERSIAL topic has been raised by Admiral Moreau in the statement he has just made on the naval policy of France. He reminds the world that it was France who made a move towards the restriction of capital ship construction long before the calling of the Washington Conference. Since the beginning of the war not a single battleship has been laid down by the French Government, and the construction of any which were on the stocks has been abandoned. In addition, without waiting for the American appeal, France decided to place on the scrap heap seven other battleships, all less than twenty years old, and to retain for service only ten units, none of which could be regarded as modern ships. The French Government, therefore, reserves the right to replace these vessels at a later date should the need arise. Admiral Moreau definitely challenges the soundness of the argument that the only useful function of the submarine is the destruction of the merchant ship. He contends that not only Admiral Sims but Admiral Lord Wemyss, who during the latter part of the war period was First Sea Lord to the British Admiralty, support Admiral le Bon, former Chief of the Staff of the French Navy, in the belief that submarines are an efficacious arm in operations against warships. Our ally requires 90,000 tons of submarines for the sole purpose, we are assured, of being able to defend the 24,000 kilom. of the coastline of France and her colonies, and, like Great Britain, to maintain her maritime communications.

Cargo-Carrying Aeroplanes.

MUCH interest has been aroused by the announcement that the Instone Air Line has decided to establish a cross-Channel service of cargo-carrying aeroplanes. According to a statement made by Sir Samuel Instone, who believes that technical and traffic developments have reached a point when an attempt should be made to lay the foundations of a British mercantile air marine, two experimental cargo aeroplanes will be in service almost immediately. It is intended to lay down a considerable fleet of machines of large carrying capacity, and, indeed, the first of these is already under construction. When the lighting of the cross-Channel airways route is completed, it is intended to operate the cargo machines by night as well as day. It is regarded as imperative that this pioneer work should be done by Great Britain without any delay, as in other countries, notably in Germany, important developments are taking place by the co-operation of shipping and air transport interests. The Hamburg-Amerika Line is now engaged in constructing at Hamburg a new dock for seaplanes into which aircraft can go regularly for overhaul and repair.

Motor Ship Operating Costs.

WITH the return of the Domala, of the British India Line, to Plymouth from Bombay, the round voyage of the first motor liner has been completed. It is understood that the propelling machinery equipment gave a satisfactory performance, and experience has shown that the consumption of oil per twenty-four hours at a speed of 13½ knots is only 19 tons, which means that on the voyage to Bombay and back a saving on the basis of the present prices of coal and oil of £2000 in fuel costs is effected. It is only ten years since the Selandia, the first of the motor ships, made her maiden voyage. The rapid progress of the Diesel-engined ship may be gathered from the statement that there are now in service about 2,000,000 tons deadweight of motor vessels.

Great Western Railway Amalgamation.

ALTHOUGH terms with the Barry Company were not arranged in time to include that company in the scheme which has just been approved by the Railway Amalgamation Tribunal, the Great Western is the first company to carry out the provisions of the Railways Act, 1921, which requires that schemes for the amalgamation of the constituent companies shall be submitted to the Tribunal by January 1st, 1923. If approved, the amalgamations will operate as from January 1st, 1922. The terms of amalgamation include the absorption of the railway-owned docks at Newport, Cardiff, Penarth, Barry, and Port Talbot. With the exception of the Swansea docks, the Government scheme provides that the Great Western Railway Company shall merge into its undertaking the chain of docks, ports and harbours stretching from the river Severn to Fishguard Harbour. The magnitude of the traffic handled is indicated by the fact that 60 per cent. of the export coal of Great Britain is shipped from the South Wales docks and ports. In addition to the constituent companies with whom terms have been arranged, the Great Western Company is required by the Railways Act of 1921 to prepare absorption schemes for taking over twenty-six other railways. Though described in the Act as subsidiary companies, they are railways of considerable importance and form valuable links in the transport system of the country. Some idea of the enormous traffic carried by the railways in the group may be gathered from the latest statistics available, which show that six of the constituent companies carried in one month last year nearly nine million passengers between them, excluding season ticket holders. In 1920 the coal output for South Wales alone was nearly 46 million tons.

Railway Rates Reduction.

THE decision of the railway companies on the application of trading organisations for a further reduction in the rates charged for the carriage of coal and general merchandise is being awaited with some anxiety. There was a general impression that an announcement on the subject would be made this week, but the meeting which took place on Tuesday last was only that of a sub-committee charged with the duty of drawing up a definite scheme for the consideration of a meeting of the General Managers' Conference next week. No official statement is likely to be made, therefore, until Wednesday or Thursday next. It is rumoured in circles which are usually well informed on such subjects that some concessions will be granted, but they will apply only to coal and to a few selected commodities mainly in the raw material and semi-manufactured classes. If this forecast should be verified there will be general disappointment in industrial and trading circles, as the demand put forward through the Federation of British Industries has been for a reduction in railway rates on general goods traffic to a point not more than 50 per cent. above pre-war level.

Aircraft in War and Peace.

IN his speech in the House of Commons on Tuesday Captain Guest dealt with the functions and the future *rôle* of the air service. He claimed that aircraft would be able, if sufficient in quantity, to defend Great Britain from invasion, and he made the prophecy that within a period of ten years combat between air forces and warships would be grotesque in its one-sidedness. His account of what is being done by other countries to develop the air arm is somewhat disquieting. Captain Guest reminded us that while we have only nineteen air squadrons abroad and twelve at home, France has between sixty and seventy squadrons for air defence, the United States twenty-seven squadrons, and that important developments are taking place in Italy and Japan. On the civil aviation side, Captain Guest predicted that as soon as the several stages of the Empire routes could be opened up and developed on commercial lines they would be at the disposal of civil aviation interests. Having regard to what is being done in Germany, it is hoped that the civil side of aviation will receive the serious consideration of the Air Ministry. There is no doubt that Germany will soon be in a position to build up a more extensive air travel system than any other country.

Thames and Lee Conservancies Inquiry.

ON Wednesday last the Minister of Transport and the Minister of Health announced that they had appointed an Inter-departmental Committee to examine the revenue and expenditure of the Thames and Lee Conservators and to consider the sources from which their revenues are derived, and to consider and report what modifications, if any, are desirable in the constitution, powers or duties of both Bodies as the result of its investigations. The Committee is composed as follows :—The Right Hon. Lord Newton, Chairman ; Mr. H. B. Betterton ; Mr. G. Hammond Etherton, Town Clerk of Liverpool ; Mr. J. R. Brooke, of the Ministry of Transport ; and Mr. R. J. Simpson, of the Ministry of Health.

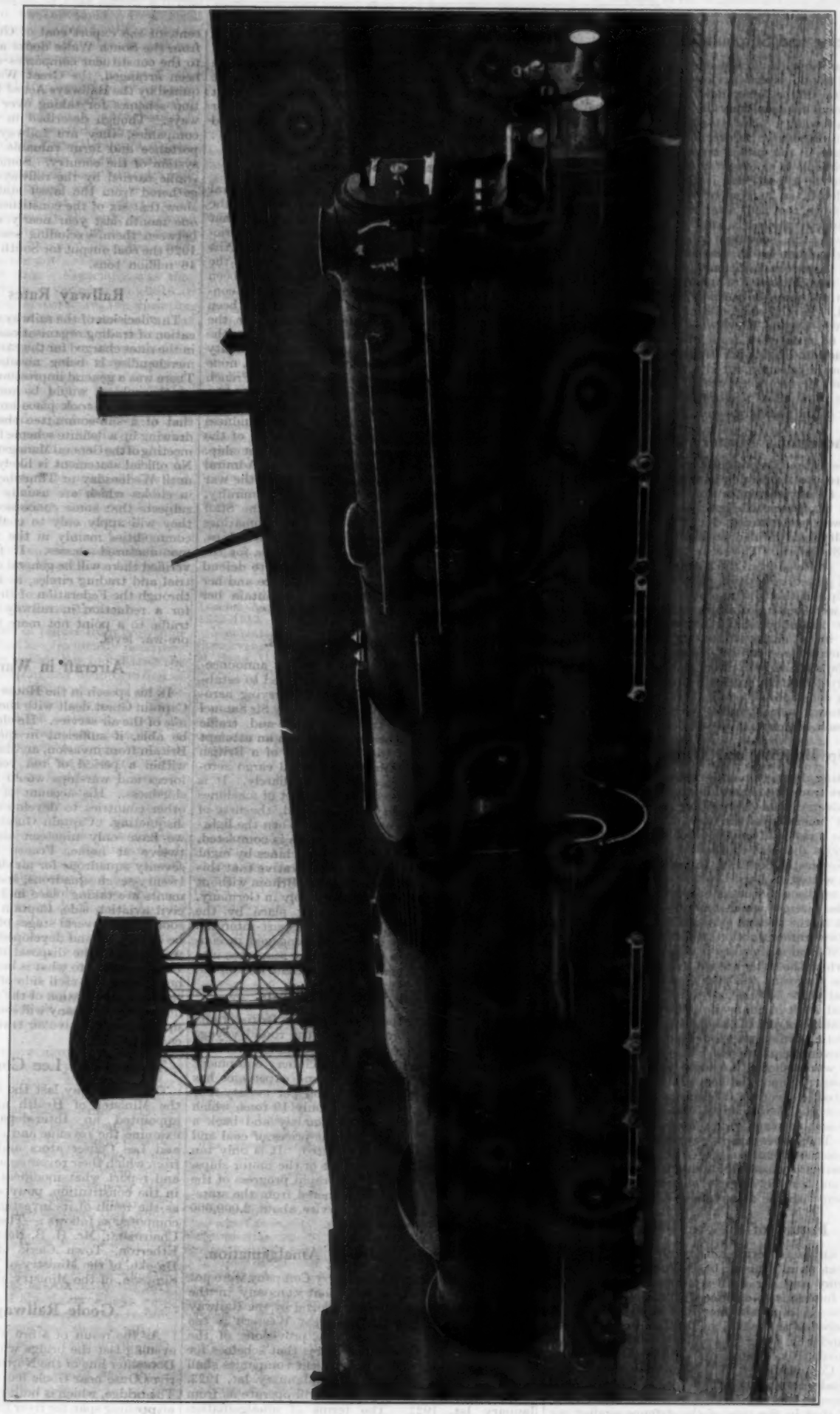
Goole Railway Bridge Fire.

As the result of a fire which occurred on Tuesday evening last the bridge which carried the main Hull Doncaster line of the North-Eastern Railway over the river Ouse near Goole has had to be closed to traffic. The bridge, which is built in six spans, one of which is an opening span for river traffic, was one of the largest of this particular type. The fire originated on the jetty which carries the opening span of the bridge, and the whole of this jetty, with the exception of a small portion on the south side, has been destroyed, as well as the hydraulic power-house. The damage to the ironwork of the structure is not great, but the bridge it is not likely to be available for traffic for some time. Services are being maintained by the Selby route.

CONDENSING TURBINE ELECTRIC LOCOMOTIVE

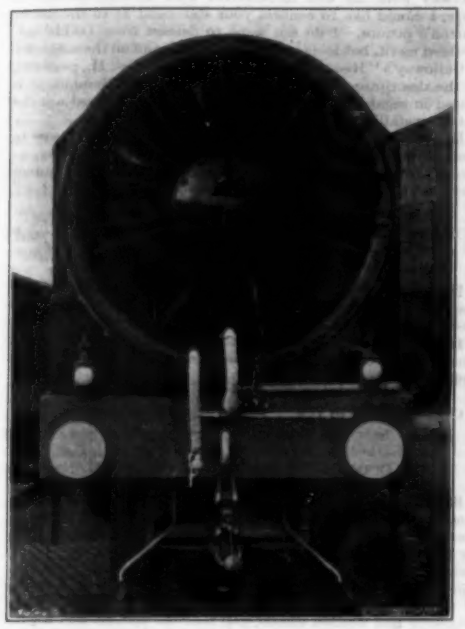
THE RAMSAY CONDENSING LOCOMOTIVE COMPANY, LIMITED, GLASGOW, ENGINEERS

(For description see opposite page)



The Ramsay Condensing Turbine Electric Locomotive.

THE experimental locomotive illustrated herewith has been designed by Mr. D. M. Ramsay, managing director of the Ramsay Condensing Locomotive Company, Limited, St. Vincent-street, Glasgow, and built at the Scotswood works of Sir W. G. Armstrong, Whitworth and Co., Limited, Newcastle-upon-Tyne, under his supervision. The engine has now gone to Horwich, where arrangements have been made by Mr. George Hughes, chief mechanical engineer of the London and North-Western Railway Company, to carry out tests under practical running conditions. We were recently afforded an opportunity of inspecting this engine in the makers' yard, where it has undergone preliminary tests. The primary object of the design is to save fuel and water, and in this connection the Ramsay Condensing Locomotive Company, Limited, claims a considerable economy in both respects as compared with existing types of locomotives.* The application of a condenser of novel form in conjunction with a steam turbine is relied upon to bring about this result, superheated steam being expanded down from boiler



REAR VIEW OF ENGINE

pressure to a vacuum of 27½in. The following are the leading particulars of this interesting experimental locomotive :—

Length overall	69ft. 7in.
Length, wheel base	59ft. 4in.
Length, rigid wheel base	16ft. 4in.
Weight on driving wheels, average	18 tons
Driving wheel diameter	4ft.
Height from rails to centre of boiler	10ft. 3in.
Width, maximum	8ft. 11in.
Weight of front engine	67 tons 5 cwt.
Weight of front engine, light	63 tons 5 cwt.
Weight of rear engine	63 tons 10 cwt.
Weight of rear engine, light	48 tons 3 cwt.
Total weight, including 2200 gallons water for cooling purposes and 4 tons coal	130 tons 15 cwt.
Total heating surface with superheater	1453 square feet
Grate area	28.4 square feet
Boiler pressure	200 lb. per sq. in.
Superheat	300 deg. Fah.
Adhesive weight	108.5 tons
Tractive force	22,000 lb.
Ration of adhesive to tractive force	11.05
Turbo-generator	890 kilowatts at 3600 revs., and 27½in. vacuum, voltage 600.
Gauge	4ft. 8½in.

Superheated steam passes to the main and auxiliary turbines and is finally exhausted to vacuum in the condenser, the condensate being drawn off from the condenser by a rotary extracting pump and returned to the hotwell, from which a feed pump delivers the water into the boiler, thus completing the cycle. The front engine, both as regards the boiler and underframe, differs but little from accepted locomotive practice, except that the reciprocating engine is displaced in favour of a turbo-generator made by the Oerlikon Company, of Zurich. The main turbine is of the impulse pressure compounded multi-stage type, connected through a flexible coupling to a three-phase generator capable of sustaining a 25 per cent. overload for half an hour. This generator is separately excited by an auxiliary turbine-driven direct-current generator. The three-phase generator supplies power to four three-phase slip-ring motors arranged in two groups on the front and rear parts of the locomotive respectively. The two motors of each group are bolted to a common stretcher carrying a countershaft, to which the motors are geared. The power is then transmitted from the countershaft to the six driving wheels on each part of the engine by coupling-rods in the ordinary manner. Each of these motors is capable of developing 275 horse-power.

The rear engine contains the coal bunker and cooling water tank, as well as the condenser and its appurtenances. The condenser forms one of the novel features of the engine. It is of the evaporative type supplied with air by a fan at the rear of the engine. The steam tubes of the condenser are arranged in the form of a cage, which is caused to revolve in water at slow speed and through which the air is impelled by the fan in a radial direction over the tubes. A flexible pipe between the two portions of the engine connects the turbine exhaust to the condenser.

The boiler is hand-fired and is fitted for forced draught. The driver operates the locomotive by means of a master controller placed in the cab. The condenser was made by the Mirrlees Watson Company and the fan for cooling purposes by Peter Brotherhood, Limited.

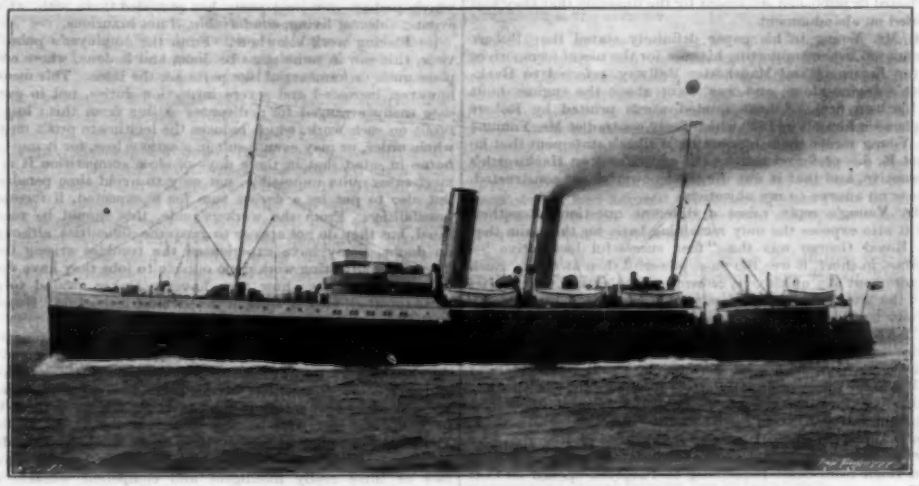
* The reader will no doubt recall the Reid-Ramsay turbine electric locomotive built by the North British Locomotive Company, Limited, Glasgow, an illustrated description of which appeared in our issue of July 8th, 1910.

The Harwich-Antwerp Passenger Steamship Malines.

THE cross-Channel passenger steamship Malines, which was built by Sir W. G. Armstrong, Whitworth and Co., Limited, at the Armstrong Yard, High Walker, Newcastle-on-Tyne, for the Great Eastern Railway Company, started on her first trip on the Harwich-Antwerp service on Wednesday last. The Malines is a twin-screw geared turbine steamer with a straight stem and a cruiser stern. her principal characteristics being :—Length overall, 337ft.; length between perpendiculars, 320ft.; breadth moulded, 43ft.; depth moulded from keel to shelter deck, 26ft. 6in.; mean draught, 13ft. 3in.; displacement when carrying a load of 170 tons deadweight, 2800 tons.

She has a 'midship deckhouse with a boat deck extending for about 110ft. amidships and continued forward as a forecastle deck. Including that in the *cabine de luxe* and the ladies' saloon, sleeping accommodation is provided for about 263 first-class passengers, while there are berths for about 112 second-class passengers, including accommodation for 10 in the ladies' saloon.

The vessel has five cargo holds, three forward and two aft, which are available for general cargo. Arrangements have also been made for carrying about ninety horses on the main and lower decks directly over No. 4 hold, while a special space has been set apart for the use of returning seamen. The vessel was designed and built to meet the full requirements of Lloyd's A1 (shelter deck with free-



O.E.R. CROSS CHANNEL STEAMER MALINES

board) class and to comply with all the requirements demanded by the Board of Trade for passenger vessels on this service. During construction she was supervised by the company's superintendents and the officers of Lloyd's Registry.

The heating of the passenger accommodation is arranged in conjunction with the ventilation arrangements and is provided by means of 5in. "Pleno-umits" supplied by the Buffalo Forge Company, Limited. The forward, 'midship and aft first-class accommodation and second-class accommodation can be supplied independently with supplies of fresh air. The "Pleno-umits" are capable of delivering air in sufficient volume to produce six changes per hour heated to a temperature of 65 deg. Fah. with an outside temperature of 20 deg. of frost. The air is distributed by means of light galvanised sheet iron trunking, fitted throughout the accommodation with louvres for controlling the air pressure. The electric generating plant consists of two reciprocating steam-driven dynamos, each having an output of 100 kilowatts at 105 volts. The engines were supplied by Messrs. Matthew Paul and Co. and the dynamos by Laurence Scott and Co. A secondary battery is fitted to supply the necessary current to the wireless telegraphy installation and such portions of electric lighting as may be necessary in an emergency. A Sperry gyro-compass, loud-speaking and intercommunication telephones and a cabin bell system are also provided. Eight lifeboats are carried on Welin's patented davits of the S.R. type.

The propelling machinery and boilers, together with a number of the engine and boiler-room auxiliary machines were supplied and installed by the Wallsend Slipway and Engineering Company, Limited, of Wallsend-on-Tyne. The twin screws are driven by turbines through mechanical gearing, an independent set of turbines and gearing being provided for each line of shafting. The ahead-going turbines for each set consist of one high-pressure and one low-pressure turbine working in series, while for astern going the turbine is incorporated with the low-pressure ahead-going turbine. There are impulse wheel stages in all the turbines and the grouping of the wheel stages is such as to provide practically an equal transmission of power through the high and low-pressure turbines. The whole of the bearings for the rotor shafts, including the adjusting blocks, are arranged to work under a system of forced lubrication, rotating and fixed oil baffles being fitted on the rotor shafts between the glands and the bearings. The gearing is of the double helical type. The wheel rims upon which the teeth are cut, as well as the main shafts, are made from ingot steel forgings, while the pinions are of nickel steel. Oil sprayers are arranged in the gear cases in such positions that they will spray oil upon the engaging teeth of the pinions and wheels. The bearings for the pinion shafts and gear wheel shaft also work under forced lubrication.

The condensing plant has been designed so that with the turbine machinery working at its full service power a vacuum of about 28½in. can be maintained with a barometer of 30in. and the usual temperature of sea water obtaining in the North Sea. The auxiliaries, which comprise centrifugal circulating pumps driven by single-cylinder engines, independent air pumps and direct-acting feed pumps, a feed heater of the surface type, a feed filter, forced lubrication pumps and oil coolers, bilge and ballast pumps, a sanitary pump, water service and fresh water pumps, exhaust into an auxiliary condenser, which has its own air and circulating pumps.

The boiler installation consists of five main boilers of the ordinary return-tube type, four of which are grouped two abreast and back to back, there being two stokeholds. The fifth boiler is arranged aft in a recess in the cross bunker between the boiler-room and engine-room. There is also a donkey boiler for harbour use. It, too, is of the return-tube type and its position is forward of the main boilers in a recess in the forward cross bunker. The total number of furnaces in the main boilers is twenty. They are of a corrugated renewable type and a separate combustion chamber is provided for each furnace. The working pressure for which the main and donkey boilers are constructed is 200 lb. per square inch. All the boilers are designed to work under forced draught. The supply of air for the forced draught system is provided by four fans, each of which is driven by a single-cylinder engine fitted with forced lubrication. Electrically driven ventilating fans are also provided in the engine-room hatchways to ensure a good circulation of air.

Following preliminary trials at moorings and at sea, the official machinery trials were carried out off the mouth of the Tyne on Thursday, the 9th inst. The builders of the vessel had given a guarantee that in ordinary service conditions, with a deadweight of 170 tons on board, the vessel would be capable, when tried upon an approved deep-sea mile, of attaining a mean speed of not less than 21 knots during a trial of six hours' duration, and that the mean speed of two runs on the measured mile under the above conditions would not be less than 21½ knots. After leaving the Tyne the machinery was worked up to full power and the six hours' full-power trial was carried out in fine weather with a westerly breeze freshening throughout the day and veering towards the north with a smooth sea and long ground swell. The mean speed attained during the six hours' run was 21.5 knots, or half a knot in excess of the guaranteed figure. Four runs were made on the measured mile course at St. Abbs—two runs in each direction—when the mean speed of the last pair of runs was 21.82 knots, that is, .32 knot in excess of the guaranteed speed. Immediately after the completion of the six hours' trial circling trials were carried out, and the vessel was afterwards driven full speed ahead to determine distance travelled in the time between the order being given to go full speed astern and the vessel losing headway. A trial was also made with the astern turbines running to determine the power and revolutions obtainable when running astern. The whole of the trials were, so we understand, eminently satisfactory to all concerned and were carried through without a hitch of any kind.

SWISS INDUSTRIES FAIR.—The sixth Swiss Industries Fair will be held at Basle from April 22nd to May 2nd next. The Fair is the direct descendant of an ancient Fair, which has been held at Basle at varying intervals since the fifteenth century. It was reorganised into its present form in 1917, in which year there were 831 exhibitors, who occupied an area of 65,000 square feet. The number of exhibitors taking part in it last year was 1054 and the space they required was 220,000 square feet. The Fair is essentially Swiss in character, its object being to promote the sale of Swiss products in the home and foreign markets. Further information may be obtained from Dr. W. Meile, manager of the Fair, 30, Gerbergasse, Basle, from the Swiss Bank Corporation, 43, Lothbury, London, E.C. 2, or from the Commercial Attaché, The Swiss Legation, 32, Queen Anne-street, London, W. 1.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

TIMOTHY HACKWORTH AND THE LOCOMOTIVE.

Sir,—Mr. Young's friendly letter encourages me to ask whether we cannot agree at any rate to settle our differences by the historical method, *i.e.*, by the production of original contemporary evidence—with synopsis of dates, rather than by the mere repetition of undocumented assertion. Which is Mr. Young's present method?

(1) I have asked him as a historian either to prove or to drop the story that George Stephenson recommended Hackworth to the Stockport and Darlington Railway, as much because he feared Hackworth's rivalry as because he appreciated his suitability for a difficult and responsible position. Mr. Young replies that in similar circumstances my own actions would be guided by the motives he ascribes to Stephenson! I fear that argument of this sort will not help us to a settlement. Incidentally, Mr. Young, as a biographer, fails to see that it would be most creditable to Hackworth's reputation to have been recommended for his qualities alone.

(2) and (3) Mr. Young repeats the story that the locomotives had failed the company, that the directors had all but decided to abandon them, and that only the success of the Royal George caused them to alter this decision. I have shown that months before Royal George started work, the directors had publicly reported the economy of locomotive as compared with horse traction. Mr. Young replies to the effect that this report was intended to deceive the shareholders.

Since assertions of this kind will not get us any further, let us try to resolve the question by synopsis of dates. It is clear that if Mr. Young is correct, the decision to abandon locomotives must have been made before the Royal George had proved herself. Now, she started regular work on November 20th, 1827,* and we will agree for the moment that her first week's performance alone caused the directors to reverse a decision which must have been made, if at all, before November. Why, then, if they had decided to abandon the locomotive were they, in October, negotiating with Stephenson for a new one?†

By this simple fact alone, Mr. Young's case falls to the ground, unless he can produce any contemporary recorded minute of the board or published statement by the directors that they had decided on abandonment.

(4) Mr. Young in his paper definitely stated that Robert Stephenson, when supporting his case for the use of locomotives on the Liverpool and Manchester Railway, referred to Hackworth's engine alone, and was silent about the engines built by his own firm. I have quoted words printed by Robert Stephenson himself in 1829 which flatly contradict Mr. Young.‡ Mr. Young meets them by quoting Walker's statement that he —not R. S.—preferred to take the experiment on Hackworth's locomotive, and that it was the most powerful yet constructed. This is no answer to my objection.

Mr. Young's reply raises a different question altogether, and it also exposes the only remaining basis for the claim that the Royal George was the "first successful locomotive"—because, in short, it was the most powerful then at work. Such an argument can quickly be reduced to the absurd. It implies that the latest, heaviest and most powerful locomotive on any railway must be its "first successful locomotive."

(7) About the first engines for Russia, I have to-day come across some valuable printed contemporary evidence as to dates, on which, with your permission, I will write later. I shall also try to get information from Russian sources. The date of opening the railway seems to be definitely established by a commemorative Russian medal in the collection of Mr. C. F. Dendy Marshall, whom I have to thank for a photograph. An inscription on the obverse reads (I translate literally):—"First Iron Road from Saint Petersburg to Pavlovsk opened 30 Octr 1837.

On the other question at issue I will leave the last word to Mr. Young, after asking him to consider a remark by the editor of the "Paston Letters," quoted in the "Literary Supplement" to your contemporary, *The Times*, March 16th. Writing of the neglect of history as compared with the physical sciences, he says:—"Historians have the remedy in their own hands. . . . Men will follow us in history as implicitly as they follow the chemist if only we will form the chemist's habit of marking where our facts end and our inferences begin."

J. G. H. Warren.

Darlington, March 20th.

THE LOCK-OUT.

Sir,—The employers, on their side, claim this as based on the common-sense principle of a man being master in his own house—an irrefutable claim. The workers' unions, on their side, as their basis of argument, insist that it is a fight by the employers to enforce overtime. Good; if this is their claim, then why not try to solve the question of overtime in a statesmanlike and practical manner, instead of talking useless nonsense about oppression, in these days of enlightenment too?

Let us assume it to be so. The problem must be solved and done with. It can be solved, and it is up to the unions themselves to do so. I make, in this matter, the following suggestion to them:—

At the very best of times, commercially, there is always a certain number of useful and skilled members out of regular employment, for a variety of causes, in every branch of the trade. There is also a large number of skilled but superannuated men on the union's books—healthy and still capable men. Why, then, not form an emergency reserve of such men?

It would then be possible in cases of rush and necessity, such as to complete a contract to time under penalty, for instance, to send these men to any point or firm asking for them, as temporary assistants, to get over such a difficulty, they working the ordinary hours of the works to which they might be sent and leaving automatically when the rush was over or the work finished, with additional pay or not, which would be a matter for discussion and settlement during the working out of the scheme.

I venture to say that such a reserve of skilled men would have the support of employers, and, properly organised, would once for all scotch the bugbear of overtime, removing one cause for growling which hitherto has been periodical.

There is but one real difficulty in the way of the realisation of this suggestion. It must be a real reserve of truly skilled men in their respective trades, and quite distinct from the usual, as at present, methods of haphazard supply. Once assured that the members of the reserve were as represented, the employer would, I believe, support it. It would prove its value. It would be a success.

In this connection the question is, Why is overtime ever necessary? Let us see. The causes are many. The impossibility of all firms holding huge stocks of raw material, for which very often no room exists, even if they could be carried, and changes in character of same; delays due to delivery; delays in allied trades; disputes; breakdowns; structural alterations, &c., are but a few of the many causes, involving the question in great complexity.

Now, what is to be done in such cases as the foregoing, through any of which a possible penalty or probable loss is to be avoided? Generally speaking, one or a combination possibly of three things:—(*a*) Temporary, unavoidable overtime, for which a firm is not itself responsible as to cause, for a necessary number of the firm's own men; (*b*) placing a portion of their rush work with other and outside firms; (*c*) taking on more men from outside.

Let us see what each of these remedies means to both employers and workmen, always assuming we are dealing with the common-sense, decent-minded of both.

(*a*) Temporary overtime means from the employer's point of view the employment of men, who an administration well knows, are capable of doing the work properly, and are accustomed to the general routine and methods of the firm, and thereafter no discharges probable to be necessary. From the workers'—not the agitator's—point of view, it means a short curtailment of their leisure hours, and even if they agree to it, they do not like it, even with increased pay; but to them it should also mean some, at most a little, self-sacrifice to assist the firm in its difficulty, and for which it is not responsible. It should mean also some, just a wee little, of loyalty to the firm, which perhaps for long years has provided them with, at all events, a decent living, comfortable, if not luxurious.

(*b*) Placing work elsewhere. From the employer's point of view, this can in some cases be done, and is done, where complete units or numbers of like parts are the issue. This means, however, increased and severe inspection duties, not in every case easily arranged for; disputes arising from this; loss of profit on such work, which reduces the legitimate profit on the whole order, or may even result in a serious loss, for it must be borne in mind that in these days of close competition it is in most cases quite impossible, not only to avoid time penalties, but also to put by a decent sum for unexpected, if foreseen, possibilities. From the workers' side, this should be recognised, but they do not appear to grasp the difficulties although, no doubt, many have experienced the troubles arising from fitting and adjusting work done outside to jobs they have done in part themselves; how they have to tinker around to get parts together, even in spite of the severest inspection. Outside work is not the solution of overtime and never will be.

(*c*) From the employer's point of view, this means generally having to take on additional men, too often unaccustomed to the class of work they are needed for, who know little or nothing of the routine or methods of the particular shop into which they enter, and who are possibly, even probably, anything but fully efficient men, this leading to further delay and friction. Then when through with, they have to be discharged, leading to more friction, strike threats, and so on. If by any chance two or three really intelligent and competent workers are engaged and do their work well and quickly, the employer wants to keep them and discharge perhaps old hands not so efficient. That means more friction and trouble From the workers' point of view, they argue that as long as there are unemployed there should be no overtime, and these odd hands needed should be at once taken from outside; that the unions will see that the right men go in for the job; but that is what in 90 per cent. of such cases they do not do, and they never guarantee any of them, and it is something they never will do properly, though in the case of a properly instituted reserve they would have this to look to.

No; the only way at present is that for temporary overtime—none but asses would wish it constantly. (*a*) is the only solution, *i.e.*, temporary overtime for one's own workmen. The position on that head seems quite clear and reasonable.

The establishment by the unions of a special reserve of skilled men on the lines suggested—fully guaranteed, capable men—would solve the overtime difficulty. It is up to them to do it.

Anyone with a better suggestion, let him put it forward.

Lincoln, March 20th. H. G. R.

MANAGERS AND EMPLOYERS.

Sir,—I see that Mr. Sumner in his presidential address to the Institute of Metals has raised the old complaint about the difficulty that employers have, or think they have, in filling managerial posts with competent men. This sort of tale has become rather fashionable of late years. Presidents, professors and others have only to reiterate it to be sure of a good hearing. I think it is high time its truth was challenged.

What of the other side of the question? What of the many good men, managers and potential managers, who cannot find competent employers? (I include company directors in the term.) Have we not all seen the spectacle of an energetic and capable manager striving to keep things going under the misdirection of a fussy, meddlesome, and tactless employer, who as often as not only holds his position by virtue of hereditary or social claims? Again, what does the average employer do to encourage young men to fit themselves for management? Often any such attempt is severely discouraged.

My own experience may interest Mr. Sumner. Many years ago I heard this same tale about the difficulty of finding competent men for managers, and I determined to fit myself for such a position. I had the good fortune to be serving in one of the best-administered engineering establishments in the country, and I attempted to take the opportunity to study the working of the whole establishment. I found every possible obstacle placed in my way, and it was only by judicious bribery and in strictest secrecy that I could learn anything.

However, I managed to get a good insight into the working of the costing, buying, estimating, ratefixing and progress departments. I also studied the social or human side of management—the gentle art of keeping men in good humour and getting the best work out of them.

As the result of my studies, I succeeded in getting a managership in a small old-fashioned works that was attempting to reorganise itself. That came to grief within two years, almost entirely through the gross blundering of the directors. I then obtained another supervisory position, which I have held for many years now. Here, again, I have seen thousands and thousands of pounds wasted through the incompetence of directors. I have been looking for a more competent employer for a long time now, and I am still looking.

For obvious reasons, I am obliged to withhold my name from publication.

March 20th. Nemo.

EARLY LOCOMOTIVES.

Sir,—I am led to trouble you again with my lucubrations by reason of your excellent review of Major Snell's book and also Mr. Warren's interesting letter in your issue of the 10th. I entirely agree with your remarks as to dates and authorities, and as an instance, the statement that the two engines built in 1830 by Isaac Dodds for the Monkland and Kirkintilloch Railway were the first locomotives with metallic pistons or rings, I should like to confirm your statement as to the use of Barton's pistons. I do not want to detract from Dodds' undoubted merit, but facts cannot be ignored, and on the authority of Galloway's "History of the Steam Engine," Vol. II., page 610, in the description of the competing engines at Rainhill, it is stated in regard to the Novelty:—"The pistons used are the patent metallic of Barton."

It is greatly to be regretted that even now statements as to rival inventions cannot be discussed without bad feeling, as Mr. Warren very correctly remarks. It is a pity we cannot carry out the wise advice of the immortal Bret Harte:—

> "I hold it is not manners for a scientific gent
> To say another is an ass—at least, to all intent,
> Nor should the individual who happens to be meant
> Reply by heaving rocks at him to any great extent."

Pardon this digression and the roughness of this letter, as I am only just getting the better of a severe illness; hence my absence from the meetings of the Newcomen Society.

It may be of passing interest to state that at my old home, Union Mills, Cranbrook, there was formerly a boiler built in 1863 by Dodds and Son.

Sidney Russell.

Cranbrook, March 21st.

LOCOMOTIVE COUNTERBALANCING.

Sir,—Mr. F. W. Brewer, in his interesting article on "Locomotive Counterbalancing," which appears in your issue of March 17th, mentions Foster and Rastrick's Agenoria, of 1829, as the earliest example of a locomotive fitted with balance weights on the wheels. While this engine now has cast iron wheels with such weights bolted on, opposite to the cranks of the driving wheels, it is practically certain that the engine originally had wooden wheels, and that the present iron wheels are probably of much later date.

The fact that the existing weights have the name Agenoria and the date 1829 cast on them does not necessarily mean that they were made in that year. There is, however, no evidence as to their actual date of construction.

March 22nd. E. A. Forward.

We hear that a hydraulic accumulator of a novel design has recently been patented in Germany. The pressure is produced by compressed air. It occupies very little space, is semi-portable, and, owing to its light weight, does not require any special foundation. It can consequently be placed on one of the upper floors of a building.

The laminated spring as at present used in automobile suspension is capable of considerable development, particularly in the direction of economy of material, resulting in reduced weight and cost. The suspension, states Mr. A. A. Remington in a paper read before the Institution of Automobile Engineers, is the part of a motor car which has undergone the least change; in fact, the development has been practically nil. Almost invariably motor cars are provided with four independent spring supports, "one at each corner." These four points of support are necessary in order to give sufficient lateral stability, and in all probability the system was copied from the horse-drawn vehicle, which presumably was copied, in turn, from the horse, which animal is provided by nature with four independent resilient supports, "one at each corner." It would appear probable that additional flexibility between the two axles, so as to enable them to accommodate road irregularities without affecting weight distribution on the springs would improve suspension, but little progress up to the present has been made in the development of suspension in this or any other direction.

The Government Research Department at Woolwich has recently undertaken an investigation to ascertain the cause of rapid decrease in output of the radiator type of Coolidge tube when continuously operated with a constant filament current. The problem becomes important when this type of tube is used in an X-ray outfit designed for constant routine examination of large quantities of articles, when it is usually desirable so to simplify the system of control that the whole operation may be carried out by comparatively unskilled labour in workshops. The investigation has shown that the surface charge theory does not account for the diminution in current through the tube, and the experiments suggest that this phenomenon is due to the liberation of gas, probably from the copper, causing a reduction of electron emission as observed by Langmuir. The remedy for the trouble is to prevent this liberation of gas, which is the result of a rise of temperature of the copper anode, comparatively small but more rapid than the rate at which the heat can be conducted along the copper rod to the radiator fins. The problem, therefore, resolves itself into that of providing adequate cooling of the anode.

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* Mr. Young before Newcomen Society, March 1st, 1922. Also Tomlinson's "North-Eastern Railway," page 143.

† Tomlinson's "North-Eastern Railway," page 146.

‡ Robt. Stephenson and Joseph Locke's "Reply to the Report of Mr. James Walker," compiled from the reports of Mr. George Stephenson, 1830, page 11. Also Walker's "Report to the Directors" (of the L. and M. Railway), 1829, page 2:—"On the 15th, Mr. Stephenson accompanied us to the Bolton Railway. . . . The principal object of our survey there was a locomotive engine made by him upon what he considers the best principle of any he has yet constructed, and the report we have since received from Mr. Sinclair, clerk to the company, to which I shall afterwards have occasion to refer, proves the great power which the engine is capable of exerting."

Railway Matters.

THE Railway Amalgamation Tribunal heard on Monday last the case of the amalgamation of the Alexandra Dock, Cambrian, Cardiff, Rhymney and Taff Vale companies with the Great Western, and approved the scheme.

OWING to feeling the weight of advancing years, Mr. Andrew Bain has retired from the chairmanship of the Great North of Scotland Railway, and Mr. Alexander Duffers, of Aberdeen, has been elected to succeed him.

IT is hoped that the conversion of the Brighton Company's line between Balham and West Croydon, *viâ* Streatham Common, Norbury, Thornton Heath and Selhurst, for electric traction will be completed by September 1st.

THE damage by fire on Tuesday last to the North-Eastern Company's swing bridge over the river Ouse east of Goole will cause great inconvenience in the communication between Goole and Hull. Traffic from the Doncaster and Wakefield directions will, however, be able to pass over the Hull and Barnsley Railway.

ON page 714 of our issue of December 30th we referred to the bi-weekly trains over the Australian east-west transcontinental railway leaving Perth before the English mails have arrived. The mail train now leaves Perth on Thursday, permitting the mails to reach Melbourne by Monday afternoon and to catch the Sydney–Brisbane express.

A QUESTION was asked in Parliament recently as to the Torrington–Hallwill Railway, promoted by the North Devon and Cornwall Junction Light Railway Company. Mr. Neal, in reply, said that tenders had been invited from three firms of good standing, and the commencement of the work at an early date was urgent, as it was intended to relieve unemployment.

THE very gratifying announcement was made last Friday that the delegates of the National Union of Railwaymen had decided to accept the proposals of the railway companies that the Scottish wages award should be extended to England and Wales. This will allow the extra pay granted in June, 1920, over and above the war bonus, to be withdrawn in corresponding instalments to the reductions made in the war bonus and for the working of the eight-hour day to be modified.

FROM a public announcement made on Friday evening last, it seems that a preliminary agreement has been signed which provides that the London and North-Western and Midland railways shall be amalgamated as from January 1st, 1923, into a new company, the name of which will be subsequently decided upon. During the current year the two companies will continue under separate management, but will work in the closest co-operation, with a view to economy and with the object of facilitating the amalgamation.

DURING the past two years some of the French railways have been experimentally employing petrol locomotives for shunting purposes, and the tests carried out by the State Railways with motor coaches hauling a number of vehicles on local lines shows that there is a tendency to employ petrol locomotives even for restricted passenger services. Two or three motor car firms have recently turned out such locomotives, the latest being constructed by Renault. Its six-cylinder engine develops 60 horse-power, and the weight of the locomotive is 19 tons.

A VERY important fact was revealed by the chairman of the North British Railway Company on the 24th ult. when speaking to the shareholders on the subject of that company's dispute with the Government. The question was asked during the trial, Why was the North British Company's claim for rolling stock expenditure so much greater than that of any other company? It is now known that this question should not have been asked, as the North British percentage of excess was not greater than that of some other companies. Among the Scottish companies alone, there were two with a greater excess; one had 50 per cent. and the other 41 per cent, as compared with the North British 34 per cent.

AT the annual meeting of the Great Western Railway Company on the 23rd ult., the chairman said that Mr. G. J. Churchward, the company's chief mechanical engineer, had left them; he had felt that the time had arrived for giving up this important office which he had held for nineteen years. It was impossible to speak too highly of Mr. Churchward's services to the company. His reputation as a mechanical engineer was so well known—being, indeed, world-wide—that it needed no tribute at the speaker's hands. In Mr. Churchward's management of the great establishment at Swindon and the other depôts, and in his development of the magnificent locomotives which they possessed, he had placed the company in a position second to none in that most essential department of railway working. Mr. C. B. Collett, who had been appointed to succeed Mr. Churchward, was imbued with Great Western traditions, and they were glad to have on the staff an engineer of his standing and ability to fill the position.

THE Whitley Councils of the railway companies, which come into operation next month, will consist of (1) local departmental committees at the various big centres, composed of eight persons—four to be elected by the men and four nominated by the company—which will discuss questions as to working hours, holiday arrangements, physical welfare, safety appliances, labour-saving appliances, loading of traffic, and other similar questions; (2) sectional councils, not more than five in number, for each railway, consisting of twelve members from each side which will deal with matters referred to them by the local councils, local application of agreements relating to wages, hours of duty, &c., and other matters which the company and its servants are mutually interested in, *e.g.*, co-operation with a view to securing increased business, greater efficiency and economy, &c.; (3) a railway council, consisting of twenty persons, ten from each side, to deal with any of the subjects open to a sectional council to handle, but which are of common interest to the staff in more than one section, and any subjects referred to it by a sectional council.

Notes and Memoranda.

THE explosion of a cast iron evaporator on the ss. Maid of Syra, an ex-German vessel, points to the necessity for providing such apparatus with adequate safety valves. One of the copper pipe heating coils gave way at the unions, with the result that high-pressure steam was admitted to the casing. The safety valve failed to relieve the pressure, the casing exploded and an engineer was killed.

AT the Alaska Experiment Station of the Bureau of Mines at Fairbanks, a study is to be made of the handling of boulders in hydraulic mining. One of the chief obstacles encountered in hydraulic mining in certain localities is the difficulty of removing huge boulders and slabs of rock in order to obtain the gold beneath them. The problem is to be studied with the view of designing some light, portable, mechanical means for doing the work.

THE Westinghouse Electric and Manufacturing Company, of Pittsburg, has built a 1000-kilovolt-ampère core type transformer, which is capable of giving a pressure of 1,000,000 volts. Some testing work has previously been done at voltages of approximately 1,000,000 volts, but these pressures were obtained by connecting two transformers in series, and having the connecting point earthed. The Westinghouse Company's transformer is believed to be the first single transformer that has given 1,000,000 volts.

AT a recent meeting of the Royal Society of Arts, Mr. E. V. Evans, the chief chemist of the South Metropolitan Gas Company, suggested in the course of a paper on "Some Solved and Unsolved Problems in Gasworks Chemistry," that the gas industry could deal, not only with the industries it was dealing with now, but also with the domestic fuel industry, for he felt certain that a time would come when a low-temperature carbonisation industry would come about if the gas industry did not take the steps to secure it.

IT is suggested in the official report on the failure of a cast iron steam pipe in a Lancashire mill, that the explosion, which unfortunately resulted in the death of three men, was due to the material of the pipe becoming fatigued by the stresses set up by the expansion and contraction of the steam pipe range during twenty-four years' service. The irregular thickness of the pipe, the method of making the joints with jointing material wholly within the bolt circle, and the inadequate fillet at the root of the flange, were undesirable features of the case.

THE *Prague Gazette* states that Dr. Horak has invented a new species of glass which, though not absolutely unbreakable, seems to be the toughest kind of glass ever produced. Receptacles made from the material, it is said, can be thrown about, made red hot and then put into cold water, and yet do not break. It is important to note, however, that this invention can only be placed upon a commercial basis when a special kind of sand has been found and is available in large quantities. At the present time this sand is said to exist only in the neighbourhood of Dresden, in comparatively small quantities.

A PROBLEM now under investigation at the Rare and Precious Metals Station of the United States Bureau of Mines, Reno, Nevada, is the collection of radium emanation by a high-temperature method, to substitute the present cumbersome method from aqueous solution. Upon the completion of this work, further study will be undertaken on the influence of radiation on gaseous reactions. At the same station Professor R. E. Nyswander, of Denver University, is completing a study of the spectrum of radium emanation. The spectra of krypton and xenon reveals, it is said, so many secondary lines, due to hydrogen, that it will be necessary to subject the gases to further purification before suitable results can be obtained.

THE director of the French military wireless service, General Ferrie, has informed the Academy of Science that the transmitting energy of the Eiffel Tower wireless station will shortly be made much more powerful. The completion of the transformation is now only a question of weeks, or at most of two or three months. General Ferrie has also stated that when the new installation is completed, the very simplest receiving sets would be able to record the Eiffel Tower messages up to a distance of 160 or 180 miles. The transmitting power of the Eiffel Tower station is being increased primarily in order to enable agriculturists all over France to receive the meteorological forecasts which are now being issued daily from the Tower for their benefit.

MINING in the Haichow district of Kiangsu, China, is rendered important by the presence of several crystal deposits in the western regions of Tunghai. Asbestos and talc are also found in good quantities. A company is reported in process of organisation for the operation of these mines. Gold is mined in the regions of "Yu Shan" or Yu Mountains, which traverse the two districts of Tunghai and Kanyu. The discovery of calcium phosphate was recently reported, and it is usually sent to Tsingtao for disposal. According to the Customs return for the first half of 1921, about 16,000 tons were transported to Tsingtao. Silver occurs in the Haichow regions. There are several very rich veins. The local merchants are reported to be inviting several mining experts to investigate the fields in order to ascertain the value of the deposits.

AT a meeting of the Birmingham Metallurgical Society, held on March 2nd, a paper was read by Mr. Ernest A. Smith, secretary of the British Non-ferrous Research Association, on "Some Modern Uses of Zinc." The author pointed out that one of the most important factors in the extension of the industrial uses of zinc had been the increasing quality of high-grade metal, resulting from the development of the electrolytic process of zinc extraction, which, through the elimination of impurities, resulted in a commercial metal of high quality. In casting zinc, the latest determination gave the melting point as 419.4 deg. Cent. Cast zinc would give sharp castings, but temperature was important in the securing of sound metal. The most suitable casting temperature had been found to be 528 deg. Cent. If cast much hotter, the castings were liable to be brittle.

Miscellanea.

JUST as we go to press, we learn with great regret that during manœuvres in the Straits of Gibraltar yesterday morning the submarine H 42 was lost with all hands, as the result of a collision with a destroyer.

H.M. TRADE COMMISSIONER at Winnipeg reports that Professor J. McGregor Smith, of the University of Alberta, Edmonton, will be pleased to receive catalogues from British firms manufacturing agricultural equipment. Such catalogues are useful in connection with lectures, and many American firms make a feature of this form of propaganda. Lantern slides illustrating methods of construction and use are also welcome.

IT is reported that British Honduras has signed a contract with an American firm involving the expenditure of 273,000 dols. for harbour improvements. The latter include the erection of a sea wall along the river front, the filling in of a basin between Fort George and the town, and the dredging of the channel and the bar of the river to a depth of 9ft. Representatives of the company are now on the ground and work will begin at once.

SOME special investigations were carried out in 1921 by the Dominion Water Power Branch of Canada on the Slave and Hay rivers, which are of interest as being in the neighbourhood of the route to the new oilfields at Fort Norman. On the power reach of the Slave River, some 20 miles long between Fitzgerald and Fort Smith, the power capacity is estimated at some 300,000 horse-power, and on the Hay River there are two attractive sites estimated at a total of 30,000 horse-power, in both cases under ordinary minimum-flow conditions.

AN attempt is shortly to be made to turn to commercial account the huge dumps, containing 150,000 tons of material, at the inactive zinc and lead mines in North Cardiganshire. The proposal is so to treat the blende ore lying in these dumps by the electrolytic process as to produce zinc. This will be a pioneering experiment so far as this country is concerned, but the electrolytic process has been adopted in Tasmania with marked success, and it is contended that there is no reason why it should not succeed equally in North Cardigan, where the excellent water-power resources will probably be utilised in connection with the scheme.

SPEAKING at the meeting of the County of London Electric Supply Company recently, Sir Henry Bentinck said the Electricity Bill now before the House of Lords would be instrumental in saving enormous capital expenditure in respect of generation by centralising the electric generators in big capital stations, and if the proposed Joint Electricity Authorities followed out this policy it would ultimately lead to an enormous expansion of the electric supply industry. Ministers and others, on behalf of the Government, had assured the industry that their interests would be protected, and that private enterprise would be given every encouragement.

AN Inland Waterways and Canals Exhibition has been arranged to take place at Essen from March 31st to April 30th next. At it, models, plans and various exhibits connected with the development of German river and canal transport will be shown. Arrangements have also been made with the various State authorities and the inland waterway shipping interests whereby plans of new schemes projected and those already in progress will be exhibited. Several of the more important German engineering and industrial concerns, including the Krupp firm, which is to show one of its large dredgers, will participate in the exhibition, in connection with which a series of meetings, for the discussion of various aspects of river and canal transport in Central Europe, are to take place.

IN its first interim report the Water Power Resources Committee recommended the institution of training facilities for engineers who were to enter the field of hydro-electric development. The Edinburgh Chamber of Commerce has considered this, and in a letter addressed to the chairman of the University Grants Committee, the Minister of Education, the Secretary for Scotland, and the President of the Board of Trade, makes a number of suggestions for the carrying out of the Committee's recommendations. It is pointed out that Scotland, owing to its natural resources, is particularly interested in hydro-electric development, and that Edinburgh, on account of the already existing facilities for the training of engineers, is the most suitable centre for the headquarters of a scheme such as that suggested by the Committee. The Chamber of Commerce accordingly recommends that the existing lectureships in hydraulics and electrical engineering at Edinburgh University and the Heriot-Watt College respectively should be used as the foundation of a system of hydro-electric training, and that an annual Government grant should be made to these two institutions to enable them to provide the necessary additional plant and apparatus.

NUREMBERG is a good example of how a town can render itself independent of transported fuel supplies, and can become an important industrial centre by means of hydro-electric power. Coal has still to be brought from Westphalia, Silesia and Saxony, but about ten or twelve years ago a few leading industrialists and bankers combined with the town councils of Nuremberg and Fürth in order to establish two large hydro-electric stations. The capacity of the older station, states the *Electrician*, is about 30,000 kilowatts, and there is a network of cables and distributors extending over nearly 50 miles. The station only supplies consumers of at least 60 kilowatts, the distribution to smaller customers being undertaken by subsidiary companies or municipal sub-stations. A larger central station, serving the whole of middle and a large part of lower Franconia, including nearly 700 towns and villages, was established in 1913. Its cables extend over more than 900 square miles and supply electric motors aggregating close on 50,000 horse-power, and well over 200,000 electric lamps. In consequence of the cheap and excellent electric service, the industrial growth of Nuremberg and the surrounding country has been rapid, and a number of new industries has been developed. In addition, it has greatly assisted in the increase of rural factories and domestic workshops.

THE SALT INDUSTRY IN CHINA

(*For description see page 319*)

FIG. 6—RIVER AT LOW WATER, DAMMED FOR NAVIGATION

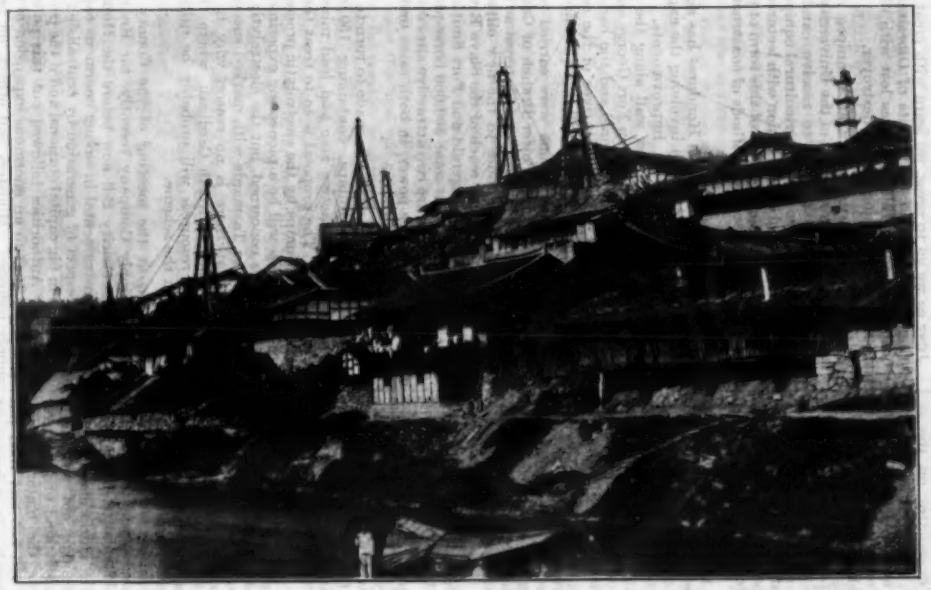

FIG. 7—WELLS IN WHICH THE BRINE IS NEAR THE SURFACE

FIG. 8—ONE OF THE EARLY WELLS, SURROUNDED BY ITS OWNER'S HOUSE

FIG. 9—SALT ON THE WAY TO THE MAIN RIVER FOR EXPORT

BRINE BAILING AND SALT PRODUCTION IN CHINA

BRINE WELLS IN DISTRICT WITHOUT GAS

BUFFALO-DRIVEN BAILING WINDLASS

HORSE-TREAD-WHEELS WORKING CHAIN OF POTS, BRINE ELEVATOR

MAN TREAD-WHEEL OPERATING CHIN-CHIA BRINE ELEVATOR

EMPTYING BRINE OUT OF BAILER

CARRYING BRINE UP TRESTLE TO GRAVITATE TO EVAPORATORS

BAMBOO PIPES LEADING FROM HEAD OF TRESTLE

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Two-page Supplement—Brine Bailing and Salt Production in China.

DEATH.

On March 15th, suddenly, at Torquay, David Decimus Coath, A.M. Inst. C.E., formerly of Rangoon, Burma, late of Holyport, Berks, aged 65.

THE ENGINEER.

MARCH 24, 1922.

Die Castings.

At a time when costs of production are exceptionally high, special interest attaches to any process which promises a notable saving in both labour and material. It is for this reason that much is to be hoped from the extended use of die castings, provided that the quality of these products can be sufficiently improved. The term "die casting" is, however, somewhat loosely used to cover a very wide range of products. Thus, in its widest sense, it may be taken to mean any casting produced by means of a "die"—that is to say, a permanent metal mould as distinguished from a sand mould which has to be made afresh for each casting. Such permanent metal moulds are used either because the relatively large cost of the "die" may be more than counterbalanced by the cost of sand moulding for each casting, or because the casting which has solidified in an iron "chill" mould possesses much better mechanical properties than one which has set more slowly in a sand mould. This characteristic is found in most metals and alloys, and affords a very distinct advantage to this type of "die casting." There is, however, the further advantage that the metal mould or die can be made much more closely to the desired dimensions of the finished article than the pattern used for sand moulding, and that the surface finish obtainable with most alloys when cooled in contact with a metal mould is superior to that obtained in sand moulds, and is free from all risk of contamination by small grains of sand. The amount of machining required on such castings is therefore much reduced.

It is by pushing this aspect of the matter to its limit that the second type of die casting has been developed. Here the object aimed at is to produce castings of such accurate dimensions and with such good surfaces that machining may be entirely eliminated. It is, of course, well known that an astonishing degree of success has been attained in this direction, and that small parts, mainly for use in the cheaper kinds of mechanism which are turned out by the hundred thousand, are produced in this way. The alloy used has to be carefully chosen from the point of view of its suitability for this kind of production, and unfortunately this quality does not always go with great strength or toughness, or even with complete physical or chemical stability. Thus, while aluminium alloys of somewhat widely varying qualities are freely used for die castings of the ordinary kind, which still require some machining, they are apparently unsuited for accurate purposes. The molten alloy does not, in this case, appear to fill the moulds to a sufficient degree of completeness, and sharp edges and fine details are not easily reproduced, while the shrinkage on solidification is also somewhat large. If, to compensate this deficiency, die-casting machines, in which the molten metal is forced into the die under pressure, are used, the melting temperatures of the aluminium alloys are somewhat high. Hence, recourse is generally had to alloys of lower melting points, such as those consisting mainly of zinc, or even of lead and tin. With these alloys very beautiful results are obtainable, but for many purposes the engineer would rightly hesitate to use them. Yet, if the die-casting industry itself is to grow to the largest possible extent, and if it is to help other industries to prosper, these difficulties need to be overcome, as well as others which we have not the space to mention here. Vigorous efforts to surmount them are being made at the present time, particularly in Germany and in America, and it is obviously most important that our British die-casting industry in all its branches and applications should not lag behind. In these circumstances, it is satisfactory to learn that both the Automobile Research Association and the Non-ferrous Metals Research Association are considering the possibility of taking up this subject. The interest in die castings, however, extends far beyond these two industries, as there are few branches of manufacture in which there would not be room for the utilisation of accurate, strong and reliable die castings. This consideration must surely lend considerably increased importance to the whole question, and it would be extremely regrettable if it had to remain in abeyance until it was found that one or both of these Associations could find time or funds to deal with it in an adequate manner.

The investigations required for the advance and development of die casting in all its branches are both of a metallurgical and a mechanical nature. The composition and treatment of the alloys to be employed in the production of different kinds of die castings, the materials of the dies and of pipes or conduits which come into contact with the molten metal, and whose character to a large extent determines the rate of setting of the casting—these are all essentially metallurgical matters. On the other hand, the design and construction of the machines to be used in die casting and the design of the moulds themselves are essentially engineering questions. There is also a further highly important matter requiring co-ordination between engineer or designer and metallurgist. It is no less than the design of the castings themselves, so as to satisfy both the requirements of the designer and the exigencies of the casting process. There is thus a fruitful field for the co-operation of engineer and metallurgist, and we wish that it might be exploited immediately under the guidance of one or more of our technical institutes, who count both classes of men among their members. The cost of such work is, however, necessarily high, and—without Government aid—is probably beyond the resources of our institutes at the present time. The "Research Association" scheme of the Government would meet such a case as this only if the die-casting industry itself were strong enough to form a special association. But it clearly is not, and the interests of so important an industry are left to be dealt with by the difficult process of co-operation between two associations, whose primary interests lie elsewhere. It is to be hoped that the Department of Scientific and Industrial Research will use what powers it may have to facilitate work on this subject. The need for it is clear and it should not be delayed by any lack of suitable organisation.

The Locomotive Hour.

It is safe to say that one of the most important problems confronting railway officers is the efficient operating of locomotives, getting the greatest possible locomotive hours per locomotive and the greatest revenue from the locomotive hours obtained. Recently, a good deal has been both written and said on the question of railway electrification, with much of which we find ourselves in agreement; but the thoughts inspired when considering these problems prompt us to ask if we are sure that we are making the best use of the motive power at present available, and if not, what can be done to render the locomotive hours more productive.

In an admirable paper on the subject of locomotive operation read before the American Society

of Mechanical Engineers in December last, Mr. W. Elmer, of the Pennsylvania system, pointed out that the locomotive spends its entire time either in the hands of the transportation department moving trains, or ready to move them, or in the hands of the motive power department being prepared or repaired. Of these conditions, the time during which the locomotive is moving trains is that which most concerns the railway as a whole, because it is then, and only then, that it is earning revenue. But the locomotive hours per driver and fireman are now limited to eight per day, and of those hours only some six or seven are really available for the needs of the transportation department. Hence, it will at once be recognised how necessary it is that engines should be kept waiting for trains as short a space of time as possible, and when running should be loaded to the limits set by the conditions of efficient operation, and by the road over which they have to run. The underloading of locomotives is a form of avoidable waste which should receive in every case immediate attention. We have at times seen it stated, that large engines on light trains are economical. A moment's consideration will show that this assertion is far from true. The modern express locomotive at 60 miles per hour requires something like 400 indicated horse-power to move itself when at the head of a train of suitable load. Part of this power is absorbed by the mechanical friction of the motion parts and coupled axles, and the rest in track and head air resistances. When such a locomotive is employed on lighter service so that the power developed is less, then, though the frictional resistance of the motion is reduced, yet if the speed is the same, the track and other resistances remain as great as before. Hence, in one case we may have the engine developing, say, 1400 horse-power at the cylinders and 1000 at the draw-bar, and in the other 700 horse-power at the cylinders and 400 at the draw-bar, a result which signifies a failure to employ 60 per cent. of the possible duty per locomotive hour. Turning to another point, let us consider shortly the problem confronting the motive power department, that of preparing and repairing locomotives. The expeditious preparing of locomotives for road service requires, in the first place, up-to-date shed accommodation. How often are sheds too small for the work expected of them, so that dead engines are standing about on outside tracks, a practice which greatly increases the time necessary to prepare them for service, especially in bad weather? How often are sheds dark and smoky, rendering the work of cleaning, inspecting and oiling engines difficult? Again, what of the lighting at night, when a lot of the preparation work is really done? Further, have all sheds proper supplies of hot water for boiler washing, and, for what is quite as important, filling up the boilers again, and thus saving coal used for steam-raising purposes? Are the coaling and watering facilities the best possible? Repairs undertaken at locomotive terminals are many and varied, and whatever they are, they require to be carried out just as expeditiously as those of a heavier nature made in the chief shops; in fact, it may often happen that less time is available. Hence, outside depôts should have well-ordered shops, equipped with up-to-date tools, wheel lathes, and the like, and, above everything else, useful lifting tackle. Engine terminals have now to provide for the needs of much larger locomotives than formerly, but unfortunately many sheds, particularly those close to railway stations in large towns, can only be extended at great expense, if at all. Yet there is no one thing more closely related to the efficiency of railway motive power than the engine terminal. This is a point we believe worthy of attention, and at a time when the outlay of vast sums is contemplated for electrification purposes, we think it possible it might be found that for a comparative small capital outlay locomotive terminals might be so modernised that we could in some instances materially increase our present locomotive hours.

Speaking at the last annual dinner of the Institution of Locomotive Engineers, Mr. Arthur Watson said, in part, as a railway man it had always appeared to him that the one thing that made for efficiency in railway operation was attention to the locomotive. The difficulty of the day was with the shortness of the locomotive hours, and the fact that eight hours' work were not given for eight hours' pay. The existence of this difficulty cannot be denied, but it can be best surmounted by allocating to a given service engines fitted for that service, and seeing to it that they are loaded to their economic capacity, and that terminal facilities are such that the work necessary to prepare and repair engines may be carried out efficiently and with the least delay, so that the time they are available for the needs of the traffic department may be as great as possible. A railway company's one product is transportation, and the locomotive provides the means whereby that commodity is sold to the public. The necessity, therefore, of attention to the locomotives so that they may earn sufficient to pay for the investment incurred in their purchase is evident.

Literature.

Real Mathematics. By ERNEST G. BECK. London: Henry Frowde and Hodder and Stoughton. Price 15s. net.

IT is not an easy task to form and express a just and fair opinion on the merits of this book. The difficulty arises from the fact that Mr. Beck does not indicate with sufficient precision for what class of reader or student he intends it. It is true that on the title page the volume is described as being "intended mainly for practical engineers, as an aid to the study and comprehension of mathematics." A careful study of the book, however, very strongly suggests that it is far less a purely instructional volume than a treatise on the reformation of mathematical teaching. It is obvious that in reviewing it our attitude towards it must, if it is meant to be the one, be greatly different from that which we should adopt if it is meant to be the other. In the first case we should deal with it non-mathematically as a work intended to assist the studies of those who, lacking the mathematical instinct, find it difficult or impossible to assimilate the instruction provided in orthodox text-books. In the second case, we should subject the book to a critical examination in an atmosphere of the highest mathematical philosophy.

Whatever the precise function which the author intended for his book may have been, it is certain that it deserves more than passing attention. Mr. Beck evidently believes that there are very many students and others who fail to make headway in mathematics simply and solely because the subject as presented in the ordinary way appears to be unreal, a matter very largely of convention and rule and quite removed from the practical affairs of everyday life. The trouble, according to Mr. Beck, arises from the mathematicians' worship of numbers and symbols for their own sake. Mr. Beck is not content to let two and two make four. He insists that the operation should be invariably identified in the minds of those performing it with the addition of a group of two definite items to a similar-sized group of similar items. In the same way ratios are not to be regarded as pure numbers, but as the relationship between the magnitudes of two groups of similar things. Powers and roots, logarithms and the trigonometrical functions are likewise all to be regarded as expressing operations upon groups of actual things. Even the calculus is to be so treated, a differential coefficient being merely the relationship between the change in the magnitude of a group of things produced by a change in the magnitude of another group of things.

In the demonstration of all these facts Mr. Beck displays great ingenuity, and especially in the case of the calculus, in which connection he demonstrates ocularly the meaning of a differential coefficient with the aid of a mechanical model consisting of sight holes, scales and graduated screens.

We readily admit that a certain class of student may find Mr. Beck's treatment of mathematics enlightening. The mathematician, however, will certainly challenge his claim that his methods introduce reality into the subject, and will doubtlessly insist that they are nothing more than a sort of mathematical Braille for the mathematically blind.

For our own part we are concerned not so much about how the student will use the book as about what he will do when, having mastered its methods, he desires to extend his mathematical knowledge. Take a specific example. The mechanical device just mentioned should enable most students to form a clear idea as to what is meant by a differential coefficient. At the same time it enables them to arrive at an expression for the differential coefficient of only one particular function, namely, x^n. The only other functions with which Mr. Beck deals are the simple trigonometrical ratios, and to differentiate them he adopts an entirely different method, to wit, a purely graphical process. What, then, will the student do when he is required to differentiate some other type of function? Is he expected to invent for himself a special method for each function, or is he expected to discover that there is a common method applicable to all functions, and that Mr. Beck's mechanical model and trigonometrical diagram, vastly different though they may seem, are really expressions of this common method? We submit that to make these discoveries the student must really possess a higher degree of latent mathematical ability than is required to enable him to follow the standard methods of differentiation expounded in the orthdox text-books. It may be that Mr. Beck argues that x^n, $\sin\theta$, $\cos\theta$, and $\tan\theta$ are the only functions which practical engineers need be able to differentiate. If he so argues, then the limitations of his methods need not be insisted upon.

The truth is that mathematicians, like poets, artists, and musicians, are born and cannot be manufactured on mass production lines. If a student cannot proceed without the aid of jigs and templates and mechanical devices and special simplified processes it is very certain that his instincts are not mathematical, and that he will never proceed beyond the point at which such assistance ceases to be available. But, fortunately, not all men, not even all engineers, are called upon to be mathematicians of the higher order. A mediocre, not to say an elementary, knowledge of mathematics suffices for their needs, and it must be admitted that to many even the small degree of knowledge required by the examinations they have to pass comes with difficulty. Mr. Beck holds that the reason is that they do not know what they are doing. They learn through a text-book, or the medium of a "coach," to juggle with figures put before them, but the processes they perform have no more real meaning to them than they would have to a Babbage calculating machine. His endeavour is to show them that they have, in fact, to do with real things in a real way. A junior schoolboy might handle the familiar formula $P L A N \div 33000$ and arrive at Horse-power. Mr. Beck would make it clear to him what he was really doing; that he was dealing with the equivalent of real weights raised through a certain height in a certain time. As a trite example that shows what he is aiming at. It is an extremely difficult object which has often been sought before and never wholly attained. Our author, as we have shown, does not completely succeed, but he has our sympathy with his attempt. The mistress of an infant school, who finds that the statement "Two and two make four" conveys nothing to her little pupils, brings understanding to them when she adds two apples to two apples. Many men to the end are doomed to remain "infants" in the upper branches of mathematics, and if to them Mr. Beck can bring light by his particular kind of "apples," he will deserve well at their hands.

We have dealt with the broad aspect of the volume rather than with details, for we deem it to be the more important of the two, but we must, before closing, express a regret that the author sometimes allows himself a looseness of expression which it is difficult to excuse in a book on mathematics. Let us give two examples.

In dealing with "imaginary" quantities, the author states that an equation involving "imaginary" roots "cannot occur in any calculations of practical engineering unless the facts be falsely stated," and that if such roots seem to be indicated the facts should be immediately re-examined to discover the fallacy or error. As a general assertion such a statement might well prove dangerously misleading to a student when he was dealing with cubic equations, to which it certainly does not apply.

Another example of carelessness of expression on the author's part—or should we say his apparent inability to appreciate the effect of his words on his readers?—occurs in the chapter on the calculus. Herein it is asserted that when we "integrate" a function we assume that the given function is a differential coefficient and that the integration is permissible and real only so long as that condition is fulfilled. "We are no more entitled," the author remarks, "to 'integrate' an expression without knowing whether it actually represents a rate of variation or not than we are to write down a quadratic equation without knowing whether it represents a real or realisable group of things." The obvious meaning of these words is that we may arrive at expressions which ostensibly represent the integrations of certain functions but which are nevertheless false and unreal because the functions integrated are not really differential coefficients. Such a misrepresentation of the truth, even though it be caused merely by the author's slipshod way of expressing himself, cannot very readily be overlooked in a work of a mathematical nature. The truth is that while all expressions can be differentiated, it is possible to integrate only a comparatively small number. If, however, we can integrate a given expression, the result is real and can be used in any way we desire, for the very fact that it is possible to integrate the expression implies, and, indeed, proves that it is a differential coefficient.

Mr. Beck has attempted an extremely difficult task. That he has not always succeeded in achieving his object is not to be wondered at. Rather should we praise him for the courage of his venture and acknowledge that in many cases he has shown the realities of mathematics and that, for those who are not naturally mathematically minded, he has provided a book which may awaken them to the inward meaning of numbers.

FROM a remark made by the chairman of the Great Southern and Western Railway, it seems that the reason the operation of the Carrigan award has been postponed for six months is that the Free State Government considered that the closing down of the railways, as a consequence of the threatened strike, in the present state of Ireland would be a contingency it could not contemplate. The result is that the company will have to draw on its share of the compensation under the Act of 1921 for nearly £70,000 to carry it over the six months.

British and American Locomotive Design and Practice.

As recorded elsewhere in this issue, a very important and practical paper bearing on locomotive design and construction was presented before the Institution of Mechanical Engineers last Friday evening by Lieut.-Col. Kitson Clark, on behalf of the author, Mr. P. C. Dewhurst, locomotive, carriage and wagon superintendent of the Jamaica Government Railways. The paper extended to nearly fifty pages of the Institution's "Proceedings," and is therefore too long to reprint in full. In view, however, of its great practical interest we have prepared the following lengthy summary of it. It will be understood, of course, that the opinions expressed and the comments made are in all cases the author's.

Methods of Designing.—The American system under which the builders are left to carry out the detailed design, general instructions alone being given them, leads to unnecessary variation in parts that ought to be standardised and interchangeable. On the other hand, in recently developed countries, engines of American design are popular because of their being fitted with compensating gear in the spring rigging, of the very rigid support given by the horn-blocks associated with bar frames, of the adequate bearing area in the axle-boxes, of the use of flangeless wheels, and because of the generous allowance of boiler power.

Boiler Power.—American practice provides a larger proportional boiler capacity for a given cylinder volume than does British. The American is the better policy, for ours leads to the boiler being overtaxed when heavy loads are met, and, in addition, results in the engine being over-proportioned for the average power exerted.

Dome Position.—The British practice of placing the dome at about the centre of the boiler barrel is preferable to the American of placing it on the last ring next the fire-box, because it removes the point of collection farther away from the point of greatest ebullition and therefore gives the drier steam. In addition, the forward position enables a higher water level to be carried at the start of a severe climb than is possible with the rearward position if priming is to be avoided.

Three and Four-cylinder Engines.—When increased power is required modern British practice, as a result of the loading gauge restrictions, tends towards the adoption of three or four cylinders. In America, in the same circumstances, a Mallet or other special type is used. American designers do not consider the increased evenness of turning moment obtained from three or four cylinders as worth the extra complications. Only a few isolated three-cylinder simple or compound engines have been tried in America. A few four-cylinder balanced simple engines have been built recently, but the practice has not extended. The three-cylinder type is considered worthy of fresh trial.

Tank Engines.—Comparatively little use is made of tank engines in America—elsewhere than in works—even the 0–6–0 and 0–8–0 standard shunting ("switching") engines being provided with tenders. The British practice of using specially designed tank engines for shunting and short trips is considered more advanced.

Outside Cylinders.—Outside cylinders have always been standard in America, and in this country, after an inside cylinder reign of many years, the same practice is now becoming adopted. The advantages of outside cylinders, such as the absence of crank axles and the easy inspection, repair and oiling of the machinery, are very real, and except for certain medium-power fast engines in which inside cylinders give slightly steadier running and reduce the radiation losses, outside cylinders are entirely to be preferred.

Main Frames.—The British plate frame has a certain amount of elasticity laterally, which fact is advantageous to the engine when on a curve. This elasticity, especially if the coupling rods are of a very rigid section, may, however, cause the axle-boxes to overheat. The American bar frame permits the use of very simple shoes and wedges for the horn-blocks, allows the springs, compensating beams, &c., under the fire-box to be placed in the frame spaces, facilitates the use of overhung springs and enables the fire-box to be widened even to the extent of overlapping the wheels beneath it without materially raising the centre line of the boiler. On the other hand, the bar frame is very weak in a vertical direction, particularly at the single top rail over the horn-blocks. In addition it has excessive lateral rigidity, restricts the size of fire-box that may be placed between the frames, and is usually weak at the front end section.

Horns.—The general width of axle-box vertical wearing surface is less with bar frames than with plate frames, but this disadvantage is more than made good by the ease with which the bar frame system permits wear to be taken up without disturbing any driven bolts or even without removing the wheels from under the engine. The shoe and wedge system of the bar frame is undoubtedly an important point in its favour. The British pattern of wedge is liable to develop considerable lateral displacement on lines with severe curvatures, whereas the American provides a good support against side thrust from the axles-boxes.

Axle-boxes and Journals.—The British axle-box brass is usually square backed and is bedded into the crown of the box. The American brass has a semi-circular crown and is inserted into the box sideways under pressure. It is, in addition, usually made without anti-friction insets and is fitted with a large brass side liner on the face next the wheel, whereas in British practice the brasses are usually lined and take the side thrust—in both directions—from collars on the axle which abut against the radiused edge of the brass. The American system is regarded as being the better, both in principle and practice.

Compensating Gear.—The use of compensating arrangements in the spring rigging of American engines has undoubtedly influenced the adoption of such engines for new and difficult tracks. Similar results could be obtained with British plate frames, for compensation is not necessarily a corollary of the bar frame. The advantages of compensation are such as to make its adoption desirable in all engines except those having few axles and designed for very high speeds.

Bogies and Bogie Frames.—The British type of bogie centre is considered superior to the American, in that it secures a better control, although it is to be noted that the longer wheel base of the average American locomotive reduces the tendency to "hunt" on straight tracks. The British type of bogie structure is also held to be superior to the American. The American bar framing for bogies places the longitudinal rigidity too far above the axle centres and is apt to be over-stressed in the top rail. Further, the cross staying is at too high a level, while the wearing surface for the axle-boxes is too small.

Pony Trucks and Radial Axle-boxes.—In America radial axle-boxes are rarely used, whereas pony trucks are probably commoner than bogies. The two-wheeled truck, it is considered, is not the equal of a bogie on severely curved lines, for in practice it throws much of the work of curving the engine on to the pair of flanges next after the truck. It is therefore impossible to place a flangeless wheel next after a pony truck, so that a longer rigid wheel base is required with a pony truck than with a bogie. Express and passenger engines in America are no longer being built with two-wheeled leading trucks, the 2–6–2 and 2–8–2 types having been displaced by the 4–6–2 and 4–8–2 types.

Boiler Construction and Materials.—While acid steel is nearly always used in Great Britain for the barrel and fire-box shell plates, basic steel is permitted and is extensively used in America. Acid steel is considered the more suitable on the ground that basic steel is held to pit and corrode more readily. The greatest difference in the boiler practice of the two countries is the use of steel for the fire-boxes in America and copper in Britain. The copper fire-box is regarded as more trustworthy and more readily repairable and maintained. Steel fire-boxes, however, can be quite successfully used under the most arduous service conditions, and in the matter of facility of repairs the advance made in electric welding leaves nothing to choose between the two materials. In American boilers all forms of crown bars have been eliminated in favour of direct stays, while Belpaire fire-boxes are comparatively scarce, whereas in this country they are very popular. The wagon-top type of boiler has not been found necessary on British engines except in the present standard Great Western "coned" boiler. In America steel or charcoal iron tubes are universally used, whereas here brass or copper is still employed. The high coefficient of expansion of copper relatively to steel results in the tube plates being far more severely stressed by distortion with copper tubes than with steel. No difficulty has been observed in keeping steel tubes tight in copper boxes. It is too early to pronounce judgment on the recent American practice of welding fire-boxes instead of forming them with riveted lap joints. Evidence, however, suggests that, whereas overheating of the crown plate of a riveted box produces sagging of the roof, in a box with a welded seam in the crown it will probably result in a disastrous explosion.

Expansion Brackets.—The British type is simple and effective, the American somewhat crude. If the fire-box extends over the frames the American practice is to support it by means of thin plates fixed to cross stays and to the front and rear of the foundation ring. These plates are considered to provide a simple and inexpensive method of holding the boiler down, but it is held that the weight of the boiler should be taken by a definite sliding connection.

Circulating Tubes and Brick Arches.—Brick arches were comparatively little used in America until recently, when circulating tubes were re-introduced. These tubes are about 3in. diameter and extend from the lower part of the front water leg to the upper part of the back leg. They are intended to promote circulation and to support the brick arch. They require careful watching and frequent cleaning to remove scale.

Fusible Plugs.—Fusible plugs are omitted from the majority of Canadian and American engines, on the grounds that (1) they sometimes leak when there has been no shortage of water, (2) they sometimes fail to act when the water is short because of the accumulation of scale on the water end, and (3) the comparatively small hole they provide is insufficient to be effective in the large boilers now used. It is considered that these objections can be overcome by the design, construction and frequent renewal of the plugs, and that fusible plugs ought not to be discarded.

Fire Holes.—The American practice of flanging the outer and inner plates towards each other and riveting them with a lap joint is regarded as open to objection on the ground of the difficulty it imposes in the way of effecting repairs. This objection is now of less moment as a result of the adoption of electric welding instead of riveting, but even so, the well-known "Webb" pattern of fire hole is held to be superior.

Fire-doors and Deflectors.—Deflectors are not generally used in America, for the reason that with the large fire-boxes in vogue they interfere too much with the distribution of the fuel on to the grate. The old swing type of fire-door held sway on most American lines until the automatic form was introduced. This type remains open only so long as the fireman's foot is on the trigger and allows little cold air to enter. Mechanical stokers, essential in many American engines, are not likely to be required in British practice with ordinary fuel, nor even for the largest boilers likely to be designed for the British loading gauges.

Fire-grates.—The American fire-grate, with its rocking and dumping sections and its relatively small air spaces, is a result of the quality of fuel used, a bituminous coal liable to clinker and generally of small size and heavily watered. Drop plates might be of advantage on some of the relatively long grates in British engines.

Ash-pans.—American ash-pans are generally more complicated than, and not so well constructed as, British ash-pans. In most large American engines difficulty is experienced in providing sufficient air inlet area, and this fact has led to the provision of openings that cannot, when required, be completely closed by the engineman. Much fuel is consequently wasted when steam is not required.

Flexible Fire-box Stays.—In modern American engines many flexible stay bolts are used, in which the flexibility is provided in the attachment to the outer shell. The expansion between the outer and inner fire-box plates is greater if the inner are of copper than if they are of steel, but the large size of the American boxes, combined with the reduced ductility of steel relatively to copper, makes the provision of flexible stays very necessary.

Domes.—Domes are similar in both countries, except that in America they are much larger, a feature in favour of obtaining dry steam and of facilitating inspection of the regulator valve.

Lagging, Cleading, &c.—The lagging practice in both countries is similar, but American cleading is inferior in the matter of the number and effectiveness of the securing clips and fastenings.

Regulators.—The still largely used British type of regulator comprising a sliding ported valve with a pilot valve and a sector handle is considered inferior to the American double-beat circular valve operated by a pull-out lever. The American valve is easier to keep tight and closes automatically if the gear should fail. The pull-out handle is prefered to the sector handle, in that it can be conveniently operated without the driver's removing his other hand from the brake handle or his eyes from the line ahead.

Internal Main Steam Pipes.—The British practice of using a copper pipe with brass sleeves brazed at the ends is preferred to the American method of using a steel tube with cast iron or cast steel sleeves riveted on, the grounds of the preference being the increased resistance to corrosion. The use of a good steel pipe with properly secured bronze end pieces is stated to make a good job.

Superheaters.—The only difference between the American Schmidt superheater and the Schmidt superheater as used in this country lies in the method employed to connect the units to the header. In British practice the joint is in the form of a ring with asbestos packing. In America the ends of the tubes are coned and are pulled into the conical seats in the header by means of a yoke bearing against spherical shoulders on the tubes. The American method is held in high esteem. On lines with severe up and down gradients dampers working with the opening and closing of the regulator are regarded as essential for the purpose of stopping the draught through the flues when steam is shut off.

Smoke-boxes.—British and American smoke-boxes differ by reason of the simplicity of the interior of the former and the complexity of the internal arrangements of the latter. The elaborate deflectors, diaphragm plates, dead plates and spark arresters in the American smoke-box are consequential upon the small soft nature of the coal generally burned. While British practice is satisfactory so far as conditions in this country are concerned, it is undoubtedly necessary to provide smoke-boxes on the American system for colonial or tropical countries where fires of enormous extent are readily started. American smoke-box fronts are in contradistinction to British practice, always made readily detachable and are frequently formed of cast iron. The ratio of the diameter of the door to the diameter of the front is, moreover, always very much smaller than in British practice. The smaller door is advantageous, in that it is less liable to warping and burning away, although it interferes with the cleaning of the tubes from the smoke-box end and entails the use of compressed air or steam cleaners inserted through the fire-box.

Blast Pipes.—Single orifice blast pipes reaching no higher than the centre of the tube area are now established in American as in British practice. Petticoat pipes are, however, rarely used nor are adjustable orifices in favour.

Smoke-box Steam Pipes.—Cast iron pipes are universally used in America with ground ring joints. The joints are very effective and might well be used with copper pipes. The extra thickness of the cast iron pipes sometimes makes it difficult to withdraw or expand certain of the tubes.

Smoke-box Fastening.—The saddle type of smoke-box is preferred to the old square set British pattern, both for plate and bar framing, on the ground that it provides a more substantial fastening, is simpler to make and is more easily kept air-tight.

Cabs.—Wooden cabs have been abandoned in America in favour of steel, as in this country. It is considered essential that cabs should be as roomy as possible, and that they should extend the full width of the footplate, so as to permit access to the running plate through doors on each side without requiring the driver to go round the side of the cab.

Boiler Mountings in Cab.—The American method of attaching the boiler mountings on the fire-box back is regarded as weak, while the general use of screw cocks instead of plug cocks, resulting in some time being taken to shut off, is another poor feature. On the other hand, approval is expressed of the American system of using a "steam turret," a brass casting on top of the fire-box within the cab connected to the dome by a large pipe and supplying steam to all steam fittings. It permits the ready addition of other fittings at any time and eliminates all other steam joints on the boiler.

Injectors.—The American self-acting re-starting injector of the lifting type with its pull-out operating handle is strongly preferred to the British screw-cock pattern, for the reasons that it "catches" the water better, gives a greater control over the rate of feed to the boiler, operates over a longer range of temperature in the water dealt with, and is less liable to become choked up.

Safety Valves.—Whilst the Ramsbottom valve is undoubtedly the safest as regards unauthorised interference with its adjustment, and the most convenient from the point of view of providing facility for the engineman to prove its action under steam, the directly loaded "pop" type used in America has the advantage that it can easily be adjusted with accuracy under steam by the repair staff. In addition it shows a reduced margin between the pressure at which blowing off begins, the maximum and the shut-down pressure. British practice places the safety valve over the fire-box at the point of maximum ebullition, and is better in this respect than the American, which places it on the dome, even although the dome in American engines is placed much farther back than it is in British engines.

Piping.—American pipe work is frequently badly carried out, the clips being insecure and the pipes in two engines of the same design not always being found in the same position.

Joints.—In American practice the joints of domes and similar large attachments are made with soft copper rings. Regulator stuffing-boxes and the like are formed with a spherically ground face which bears directly against a ground spherical seating in the boiler plate. The steam pipe joint in the smoke-box is made by means of a loose ring interposed between the two flanges and formed with a plain ground face on one side and a spherically ground face on the other, the pipe ends being plain and spherically ground to match. All these forms of joint are considered superior to the common asbestos or copper asbestos flat-faced joints found in British practice.

Reversing Gear.—Steam reversing gear is nearly always now fitted on American engines of any size. Until fairly recently, however, the old-fashioned hand lever was in extensive use, while screw reversing gear was not very common. The lever is still retained in some fairly heavy American engines and in most British goods engines, although it is known that on engines so equipped the drivers do not follow and take advantage of the variations of gradient, with the result that much coal is wasted. A combined screw and lever gear might be advantageously used in some engines. The usual American method of balancing the reversing shaft is to use springs, but save where lightness is a consideration, it seems preferable to employ weights as in British practice. The reach rod from the reversing gear to the reversing shaft is, in America, often of tubing with forked ends screwed on. Such rods are cheaper, lighter, stiffer, and more readily adjusted for minor alterations in length than those commonly used in this country.

Valve Gear, Motions.—Walschaerts valve gear is now practically universally adopted in the United States, although long after outside cylinders had become extensively used inside valve gear with rocking levers was extensively employed. At one time solid excentric sheaves cast on to the axle or bored and fitted to it before the wheels were applied were prominently met with in American engines, although they had been tried and discarded by the Midland Railway in the eighties. Nothing can be said in their favour, for they eventually become slack, cannot be satisfactorily repaired and have to be removed and replaced by sheaves of the usual pattern. The link motion formerly used on American engines was frequently complicated, the rods were nearly always bent, and the pins were of much smaller diameter than is usual in British practice.

Distribution Valves.—The practice of the two countries with respect to piston valves is substantially identical, except that in America it is customary, with good results, to combine the valve spindle guides in one casting with the steam chest covers. In former times the American system of using large balanced slide valves of cast iron contrasted favourably with the British practice of employing small shallow unbalanced valves of bronze.

Pistons.—In America attention is now being given to the use of rolled and cast steel pistons with a view to reducing weight. Piston tail rods are not commonly used, and where they are employed they are associated with pistons of 27in. and upwards in diameter, whereas in this country they are applied to pistons over 19in. or 19½in. diameter. A good feature in American practice is the use of piston-rods of sufficient length to permit the withdrawal of the piston from the cylinder far enough for the renewal of the rings without breaking the crosshead joint. Poor features are the riveting over of the thread at the nut end of the rod and the use of tapered ends of considerably less diameter than the plain part of the rod.

Crossheads and Slide Bars.—Little difference is to be found in the practice of the two countries with respect to these details. The "Laird" arrangement with two bars above the piston-rod is sometimes used in both countries, and is a very good type for new and loose tracks.

Connecting-rods.—Practice with respect to the small ends of connecting-rods is similar. For the big ends the old "strap" type is generally favoured in America, whereas in this country open-end or closed-end rods are now generally used on outside cylinder engines. The strap type suffers from the disadvantage that a large mass of metal is concentrated in an unfavourable position.

Coupling Rods, Crank Pins and Bushes.—American coupling rod pins, knuckle joint points and the sections of the rods themselves are usually greater in the vertical dimensions and less in the horizontal than they are in this country. As a result the size of cylinders that can be used to drive outside the coupling rods is increased, while the lateral flexibility of the rods is made greater, a point of importance on severely curved lines. The method of fastening coupling-rod bushes consists in America of using either a set screw inserted from beneath or a combined oil cup and set screw inserted from above. In this country a key on the side is commonly employed. The British method is regarded as the only one suited for heavy duty. The American methods, particularly the second named, give trouble by the working loose of the screw.

Wheels and Tires.—Cast steel wheel centres are generally employed in both countries, except for some goods and shunting engines, for which cast iron is used. Cast iron, it is noted, lingered in American practice long after cast steel came into favour here. American tires are provided with a small lip on the outside and are secured by shrinkage alone. The shrinkage allowance is about 50 per cent. greater than in British practice. Mansell and similar types of security rings have been used on some recent American passenger engines. Experience shows that broken tires generally fracture through the holes of the set screw fastening, thus indicating the desirability of dispensing with such set screws.

Lubrication.—American railways use an oil of heavier body than British and apply it in the axle-boxes by means of saturated "elastic packing"—cotton and wool waste with a little horsehair saturated and strained. Slide bars, motions, &c., are lubricated as in British practice, except that the oil supply is controlled by needle valves instead of trimmings. Much use is now being made of grease in place of oil. Lubricators of the "Furness" type, coming automatically into action when the engine is drifting, are not used in America, for the practice there is to run down hill with the throttle or a special valve for the purpose just open enough to supply steam for lubrication. The elastic packing system is stated to require more attention and to result in more hot boxes than the British system, but it is characterised as economical.

Sand Boxes and Sanding Gear.—The outstanding differences in the practices of the two countries are in the position of the sand box and the use of steam as compared with compressed air. The American method of carrying the sand in a box on top of the boiler is intended to keep the sand dry. It is, however, sometimes conducive to the sweating and packing of the sand, makes it difficult for the fireman to remove any temporary obstruction in the flow, and incurs the risk of sand getting into the motion when the box is being filled. Steam sanding is held to have the advantage of cleaning the rails. With compressed air sanding, however, greater liberty is permitted in arranging the run of the pipes.

Brake Gear.—No discussion is attempted of the question of air *versus* vacuum brakes, minor details connected with the brake gear alone being considered. In America the brake blocks are nearly always placed at the backs of the wheels. If placed in front they add the pull on the blocks to the weight of the engine and affect the springs unfavourably. The best position for the brake cylinder is considered to be that generally adopted for it in the United States, namely, between the frames under the front ring of the boiler. In that position a very straightforward arrangement of the levers and rods is possible and there is no danger of the piston leathers perishing quickly as there is if the cylinders are placed towards the rear within reach of the heat of the fire-box. The trouble taken in America to equalise the brake gear for wear is regarded as of doubtful necessity.

Couplings and Draw Gear.—Central automatic couplers as used in America are considered superior to the old British system comprising hooks, links, draw-bars and side buffers, on the ground that side buffers increase the resistance of trains rounding sharp corners, while the links and hooks are not sufficiently strong for American and some colonial needs. Automatic couplers, however, are inferior to the British screw coupling, in that they always possess a certain amount of play, which in certain circumstances may result in the train being appreciably jerked when starting. The usual methods adopted in America for coupling engines and tenders together are open to criticism, in that in many cases no spring arrangement is fitted, so that an allowance of slack has to be made when on the straight, with consequent jerking and stress on the draw gear.

Tenders.—The British tender is constructed after the manner of a locomotive as regards its main frames, axle-boxes, &c. The American tender, on the other hand, is built in the style of a wagon, with frames of steel channels and bogie trucks of the wagon type. The American tender usually lasts about fifteen years, whereas a British tender has a life of about forty years and often survives its original engine. The commonest type of American tender tank is the U-shaped pattern and is inferior to the British type with a sloping water bottom, on the grounds that it is not fundamentally self-trimming and requires the fireman to stoop to shovel from the bottom of the coal. In America hardly any use is made of the water trough pick-up system.

Chilled Cast Iron Wheels.—Chilled cast iron wheels combining wheel and tire in one unit are not now used on engines, but only on wagons. Although less reliable than any other form of wheel, their cheapness and simplicity justify their use in many countries. Condemned wheels can be satisfactorily used in the foundry for re-casting purposes. With 15 per cent. of pig added they have been successfully employed for casting cylinders, spoked wheels, &c.

Coal Consumption.—Three British engines of the 4–8–0 type were tested against two American engines of the same type on identical services on a hilly section of the Jamaica Government Railways. The British engines showed an average coal consumption of 72 lb. per engine mile, while the American gave 76 lb. The British engines were subsequently rebuilt with boilers of 50 per cent. larger size. With greater loads than in the previous tests they showed an average coal consumption of 81 lb. per mile. The American engines under the same conditions gave 91 lb. per mile. These figures incidentally show the advantage to be derived from a large boiler, for the increase in the British engine consumption with the increased load was less than that in the consumption of the American engines.

The Formal Opening of Waterloo Station.

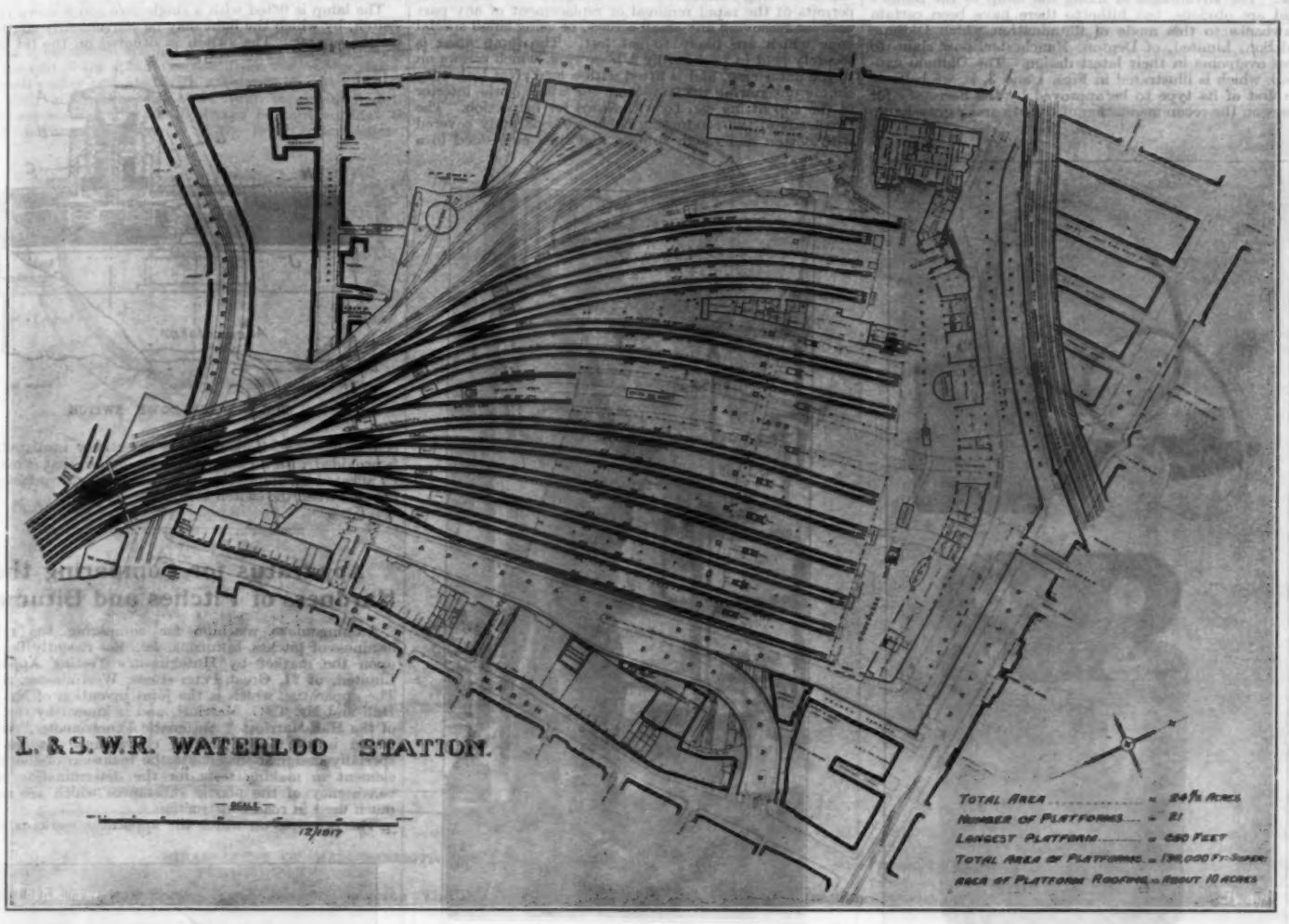
IT was in 1839 that the London and Southampton Railway Company changed its name to the London and South-Western Railway. Its first terminus in London was at Nine Elms, whence the line to Woking was opened in May, 1838. On June 30th, 1848, it was proposed to open an extension of this line to the "Waterloo Bridge Station." The section was inspected by Captain Laffan on behalf of the Boartl of Trade on the 28th and again on the 29th, but he refused to approve it, on the ground that the roads were very roughly laid and without ballast. The company made a strong protest against the postponement, but it had to make the deficiencies good, and on July 6th and 7th Captain Simmons made an inspection, and the line was then passed and opened on July 11th, 1848. The Waterloo Station had at that time four platforms.

In 1860 the station was extended on the north side in order to deal better with the Windsor traffic, and the number of platform lines was increased to eleven, which were all available for arrival and departure traffic. In 1867 the first "A" signal-box at Waterloo was opened, and in 1874 it was replaced by a larger one. At that time the average number of loaded and empty trains and light engines was 390 a day. In 1878 the South Station, with two additional platforms, was opened and in 1885 the North Station was enlarged by five additional platforms, and the "A" box then contained 209 levers. By this time the average number of trains and light engines daily was 650, of which 460 were passenger trains; whilst in 1890 the number was increased to 700 a day. The record of some of the busier days of 1891 was as follows:—Easter Monday, 811; Friday, July 10th, 809; Saturday, July 11th, 857; Saturday, July 18th, 849; and Saturday, August 1st, 823. It was in 1892 that the re-signalling of Waterloo Station was completed, the work of disconnecting, re-connecting, and coupling up the additional signalling at the "A" box occupying from May 1st to 22nd. The new locking frame contained 236 levers, which, by the use of selecting arrangements, did the work of 350 levers.

In 1899 the railway company obtained parliamentary powers to enlarge and reform the station, converting the three separate stations, each with its own approach and booking-office, which then existed, into one. The lay-out of the station yard, fifteen platforms and six running lines

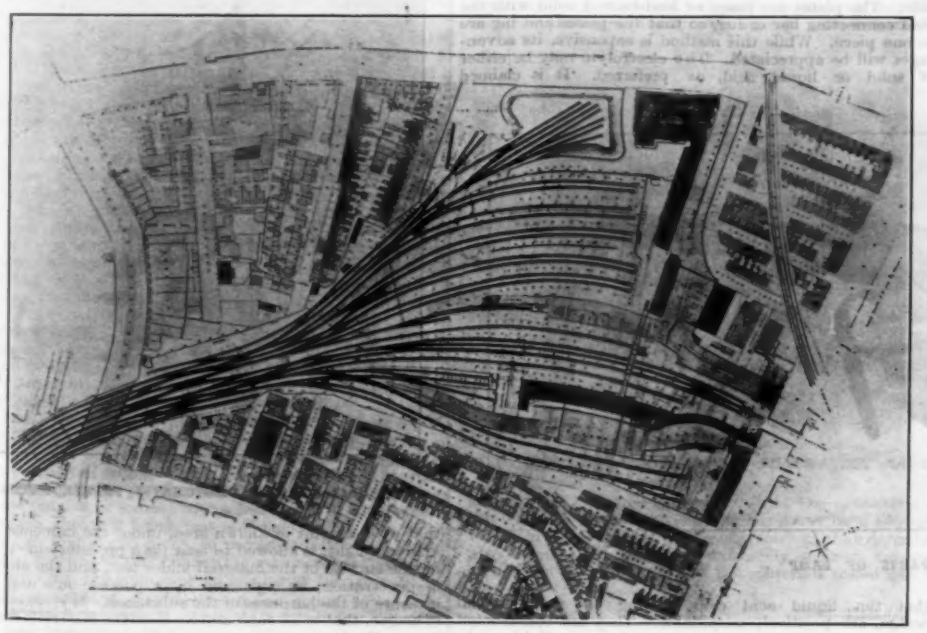
L. AND S.W. RAILWAY—PLAN OF WATERLOO STATION AS IT AT PRESENT EXISTS

THE LATE MR. J. W. JACOMB-HOOD, M. INST. C.E., AND MR. A. W. SZLUMPER, M. INST. C.E., ENGINEERS


L. & S.W.R. WATERLOO STATION.
SCALE
12 INCHES
TOTAL AREA ... = 24½ ACRES
NUMBER OF PLATFORMS ... = 21
LONGEST PLATFORM ... = 690 FEET
TOTAL AREA OF PLATFORMS ... = 130,000 Ft. SUPERF.
AREA OF PLATFORM ROOFING = ABOUT 10 ACRES

outside the station about this date is seen in one of our illustrations.

Outside the station there are now eight running roads, which, taken from south to north, are in the following order:—Down main local, down main through, down Windsor local, down Windsor through, up through relief, up through, up local, and up Windsor. There are twenty-one platform roads, which are served as follows:—From the up through relief to Nos. 1 to 6 inclusive; from the up through to Nos. 4 to 16 inclusive; from the up local to Nos. 7 to 16 inclusive; and from the up Windsor to Nos. 13 to 21 inclusive. To the down main local from Nos. 1 to 10 inclusive; to the down main through from Nos. 4 to 10 inclusive; to the down Windsor local from Nos. 7 to 16 inclusive; and to the down Windsor through from Nos. 13 to 21 inclusive. Nos. 1 to 15 platforms vary from 610ft. to 860ft. in length and Nos. 16 to 21 platforms are from 531ft. to 615ft. in length. About 500ft. of the length of the platform are under the roof. No platform is less than 30ft. in width, and some are 39ft. wide. It will be noticed that there are no crossover roads near the buffer stops, so that the whole length is available for standing purposes. Mention of buffer stops leads to the observation that the station is entered on a falling gradient and Ransome and Rapier's hydraulic buffer stops are therefore provided.



PLAN OF WATERLOO STATION AS IT WAS IN 1900

Standing for empty cabs is given between Nos. 11 and 12 platform lines, the approach being by an incline from a road under the station and entering off York-road. Cabs, when loaded, pass out by the cab exit into the station approach and thence into either York-road or Lower Marsh. Vehicles with passengers leaving by train come to the station by either the York-road entrance or that from Lower Marsh, and unload under cover at the booking hall in the north-east corner of the station. Foot passengers may enter and leave by the memorial arch near the York-road gateway or by a low-level entrance in the Waterloo-road, which is connected with two stairways in the concourse. The concourse is about 75ft. wide and gives access to every platform. Under the station, and having access by steps to each platform, is a passenger subway, which also provides the quickest means of communication with the Waterloo and City and the Baker-street and Waterloo Railways. Parallel with this subway, but at a lower level, is a luggage subway, which is connected to the platforms by a lift for each platform. An escalator has been provided between the concourse and the Waterloo and City Station.

The ridge and furrow roof consists of four bays of 120ft. span each and one of 80ft. span carried on rows of columns at 60ft. centres. The columns are 36ft. 6in. in length. The steel work for the roof was supplied by Head, Wrightson and Co., and the roof is provided with the "Invincible" glazing of W. E. Rendle and Co.

The booking-office, cloak room, refreshment room, telegraph office, waiting rooms, gentlemen's lavatory, &c., form the eastern boundary of the station, and above are the offices of the railway company.

It should be remarked in conclusion that the extensive service of electric trains now running into and out of Waterloo was opened in 1915, and that the number of passenger trains using the station, i.e., entering and departing, is over 1200 a day. The main part of the design of the station and the commencement of the work was undertaken by Mr. J. W. Jacomb-Hood, the company's chief engineer until his death in 1913. It has been finished by Mr. A. W. Szlumper, the present chief engineer, who has been good enough to lend us the diagrams from which our illustrations have been prepared. The resident engineer for both engineers was Mr. R. D. Hawes, the new works assistant. The general contractors were Perry and Co. (Bow), Limited, and it may be observed that at the recent annual meeting of the railway company the chairman said: "It is a matter of very great regret that Sir Herbert Bartlett died last autumn and is unable to be with us to-day or to see the completion of the great work which he, as head of the firm of our contractors, has carried out in the face of very great difficulties." On Tuesday afternoon last her Majesty the Queen formally declared this enlarged station open and unveiled the memorial to those servants of the company who gave their lives in the Great War.

At the North Central Station of the Bureau of Mines at Minneapolis, Minn., a study is being made, in co-operation with the Minnesota State Mining Experiment Station, of the churn drills used by the Mesabi Iron Company, for determining the most efficient shape, composition and heat treatment. The drills are being heat-treated at the Bureau station and returned for service in the field, where accurate data of performance are recorded for study.

Electric Cap-Lamp for Miners.

THE principle of the cap lamp for miners is by no means new. The advantages of fixing the lamp to the miner's head are obvious, but hitherto there have been certain drawbacks to this mode of illumination which Oldham and Son, Limited, of Denton, Manchester, now claim to have overcome in their latest design. The Oldham cap-lamp, which is illustrated in Figs. 1 and 3, is, we believe, the first of its type to be approved by the Secretary for Mines on the recommendation of the Miners' Safety Lamp

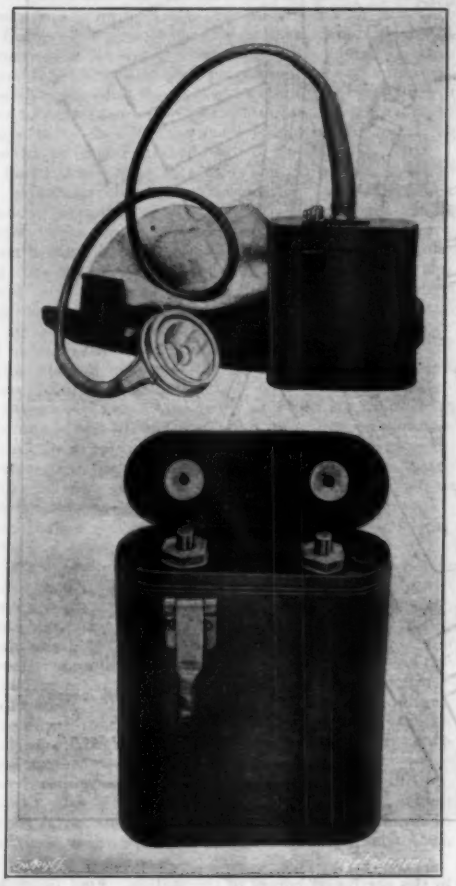


FIG. 1—COMPLETE LAMP EQUIPMENT AND BATTERY

Committee, after having passed severe tests at Eskmeals Experimental Station. The equipment, the weight of which is 5 lb. 12 oz., includes an accumulator of a capacity capable of supplying a 2½ candle lamp with current for a period of about ten hours. It is contained in a metal case, which is secured to a belt for attachment to the miner's body. The case measures 6in. high by 5in. long and 1¾in. wide. From the case a cable is connected to the bulb terminals through a specially designed supporting elbow, made in one piece with the outer case of the cap fitting, the latter weighing complete about 8 oz. A strong supporting spring through which the cable is carried is fitted to this elbow, and supporting springs are also provided to strengthen the cable against damage by bending where it enters the accumulator case, while a clamp nut is provided at the lamp end of the cable to prevent any stress, due to tension on the cable, being imparted to the reflector or contacts. These arrangements are clearly shown in the dismembered view of the lamp—Fig. 2. A feature of the lamp is that it diffuses the light through an inclusive angle of 130 deg., so that no unilluminated places can come within the vision of the miner, in whatever direction the eyes or head may be turned.

The cap fitting, which is strongly made, has an outer case made of an aluminium casting of semi-spherical shape. Fitting closely within the outer case is an aluminium reflector designed to carry a two-volt lamp bulb and the electrical connections. The reflector part of the lamp forms the actual lamp, the outer case being merely a protector for the inner reflector, which contains several important improvements, complicated arrangement of contacts being eliminated. The design of the cap fitting permits of the rapid removal or replacement of any part without removing any small screws, or using small special keys which are likely to get lost. The lamp glass is securely held in position by a lense ring, which screws on to the outer case, and is fitted with a lead rivet lock. By simply unscrewing the lense ring, the whole of the interior of the cap fitting can be withdrawn for inspection. The two leads of the conducting cable are separately covered with cotton and tough rubber, and then embedded in a thick outer covering of hard cab tire rubber—a robust form of construction, which, together with the reinforcing springs at either end, should ensure that no internal breakage of the leads can occur.

FIG. 3—MINER WITH LAMP EQUIPMENT FITTED

The accumulators—one of which is shown in the lower view in Fig. 1—are of special design and construction, both as regards the case and the plates. The latter are of the staggered grid cage pattern, with a continuous sheet of active material interlocked between the grids on each side. The plates are fused or lead-burned solid with the lead connecting bar or lug, so that the plates and lug are in one piece. While this method is expensive, its advantages will be appreciated. The electrolyte may be either of solid or liquid acid, as preferred. It is claimed that the liquid acid cells, owing to their special design, are positively unspillable. They are constructed on the well known lines of the unspillable ink-pot. The battery plates are arranged in celluloid boxes fitted with patented combined spring plunger terminals and grease cups. The celluloid box fits within a steel containing case, which is provided with a hinged lid that is automatically locked when closed. This lock, which is of heavy pattern, can only be released magnetically and its use effectually prevents any unauthorised person from opening the accumulator case. If desired, a lead rivet lock can be supplied in place of the magnetic lock. The lid of the case containing the accumulator accommodates an ebonite block which carries the terminal connections for the cable, and also two contact discs for making connection with the accumulator plunger terminals. With the exception of the faces of the accumulator contact discs, all connections inside the containing case are embedded in the ebonite block and protected from acid fumes.

The lamp is fitted with a single-pole screw-down rotary switch, by which the light may be conveniently controlled by the wearer. The switch is situated on the lid of the containing case, from which it is entirely insulated, and is provided with nickel spring contacts, so that it may not be affected by vibration, definite continuous contact being ensured when the switch is closed.

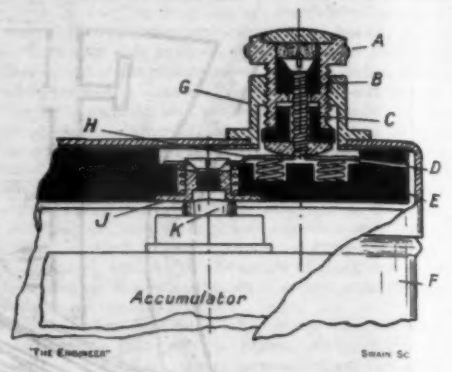


FIG. 4—SCREW-DOWN SWITCH

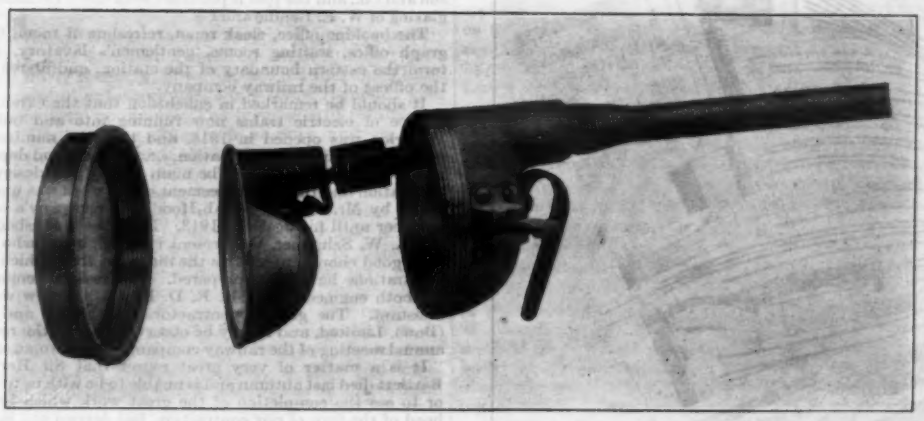


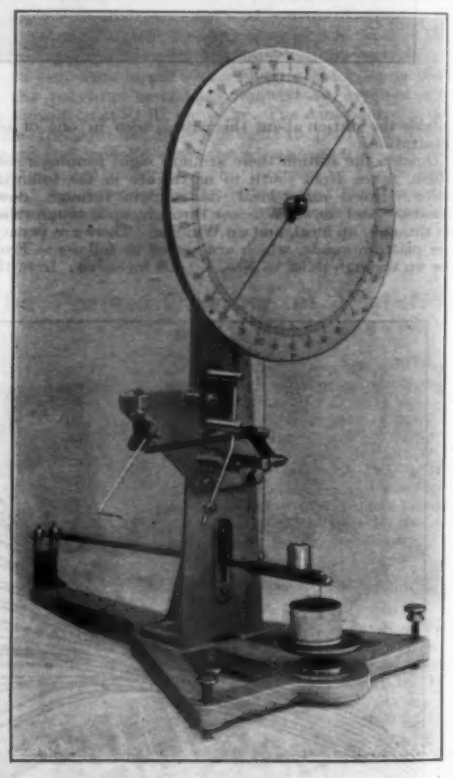
FIG. 2—COMPONENT PARTS OF LAMP

Apparatus for Comparing the Hardness of Pitches and Bitumens.

AN ingenious machine for comparing the relative hardness of pitches, bitumens, &c., has recently been put upon the market by Hutchinson's Testing Apparatus, Limited, of 21, Great Peter-street, Westminster, S.W. 1. The apparatus, which is the joint invention of Mr. B. J. Hall and Mr. T. G. Marriott, and is known by the name of the Hall-Marriott "Automatic Penetrometer," is illustrated in the accompanying engravings. It has been specially designed to obviate the inclusion of the human element in making tests for the determination of the consistency of the plastic substances which are now so much used in road construction.

The principle on which the apparatus works is simply that a steel point of known area, under the influence of a known weight, is allowed to bear for a predetermined time on the surface of the material under test, and the amount of penetration, as registered by a pointer on a dial, is a measure of the hardness of the substance. It is necessary, of course, that in all comparative tests the materials should be at the same temperature. The principle may be simple enough, but it was not so easy to put into practice, one of the chief difficulties being so to arrange matters that the pressure should be applied in each case for exactly the same length of time. The method of ensuring the necessary accuracy in timing, which was chosen as the result of long and careful experiment, is to employ a weighted pendulum swinging through a known angle, which, at the end of its course, actuates releasing mechanism which prevents any further penetration of the needle point into the material under test.

As will be seen in the engravings, the instrument stands



THE HALL-MARRIOTT AUTOMATIC PENETROMETER

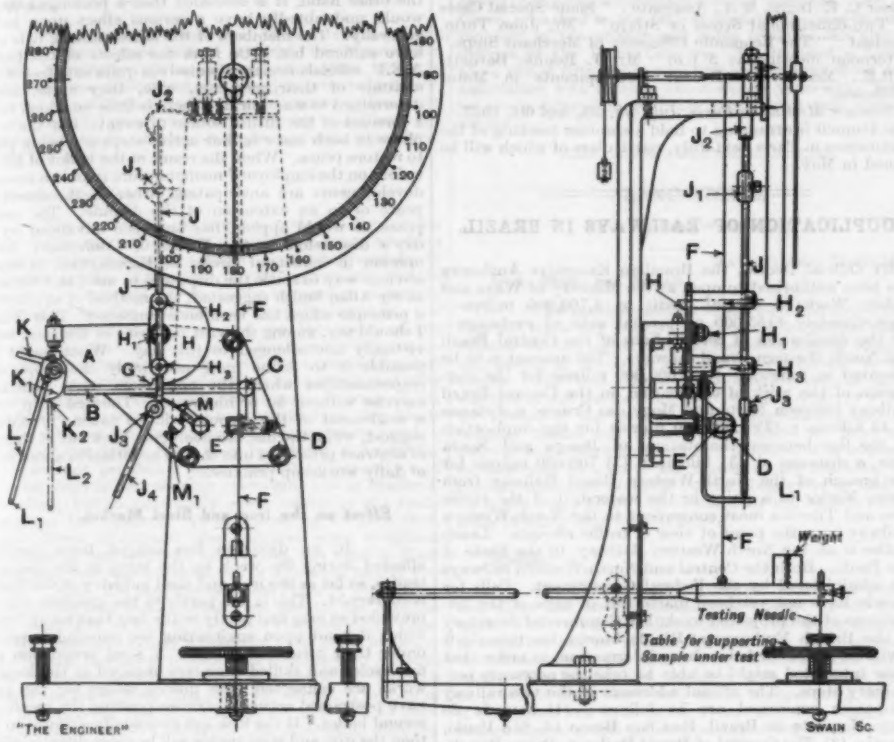
on a triangular bed which rests on three feet, two of which—those to the front—are adjustable so that the table on which the test specimen is placed may be made truly horizontal. At the end of the rear branch of the table is mounted a bracket which carries supporting points for the trunnion bearings of a gun-metal lever, which is thickened at its front end so as to increase its weight. Supporting the lever is a fine thread or cord, which is taken up vertically and wound several times round a horizontal spindle which carries the dial pointer. At the end of the spindle remote from the pointer there is a small pulley provided with a balance weight and cord, the duty of which is two-fold: first, to ensure that the lever-supporting cord shall always be taut so that the least downward movement of the lever is immediately transmitted to the dial pointer; and, secondly, to bring the latter back when a test has been performed and the lever is raised. Projecting downwards from near the end of the lever is a socket, furnished with a milled-headed screw, for the reception and clamping of the testing needle. On the top of the lever, just to the rear of the needle socket, is a known weight; in the case of the apparatus which we examined it was 100 grammes.

Immediately beneath the needle point is a circular horizontal metal table furnished with a downwardly projecting screw, which works in a threaded hole in the base, and by means of which the height of the table can be adjusted. To the rear of the table is a standard, in a central slot, in which the testing lever is free to move up and down vertically. The top of the standard is furnished with bearings in which the pointer spindle, already alluded to, revolves.

Screwed to the front of the standard, at about the centre of its height, is an irregularly shaped bracket A. On it is pivoted at C a right-angled lever with a long arm B and a short arm D. The latter, which is furnished with a spring-controlled plunger, is, when the lever is in the position shown on the drawing, pushed against the stop or abutment E. The lever arm B, it may be mentioned, always tends to take up the position shown in the drawing, because of the pressure exerted on it by the spring M, the amount of pressure being controlled by the screw M^1. The cord F, which supports the hardness-testing lever, passes between the spring-controlled plunger of the lever D and the stop E, and when the lever is in the position shown in the engraving, the cord is gripped sufficiently tightly to hold the testing lever suspended so that it cannot descend. The long arm B of the right-angled lever has projecting upwards from it a square-shaped lug G, which is shown in the drawing as engaging in a notch of the same shape cut in the semi-circular plate H. This plate is designed to revolve on a pivot pin H^1, and is furnished with two posts H^2 and H^3 through holes in which is threaded the rod J, which is held in position by clamping screws. On the upper part of the rod is a weight J^1, the position of which can be adjusted. The lower end J^4 of the rod J is bent as shown, and on it slides a weight J^3, the position of which can be also changed for adjustment purposes. In the position shown in the drawing, the top of the rod J is in contact with a leaf spring J^3, the pressure between the two being just sufficient, when the rod is freed so that it can pivot, to press the latter slightly out of the vertical so that, under the action of gravity on the weight J^1, it will commence to revolve on the pivot H^1.

To the left of the bracket A is another right-angled lever, the longer arm L of which terminates in a portion L^1 bent forward at right angles. When the shorter arm K of this lever is depressed, the end of the lever B is forced down the cam K^1 and becomes engaged in the notch K^2, the lever L then taking up the position shown by dotted lines at L^2. In the process the lever arm B has been depressed sufficiently to disengage the lug G from the notch in the plate H, and for the pressure between the arm D and the stop E to be removed so that the cord F is released. Immediately the lug G is released from the notch in the plate H, the spring J^2 just presses the rod J out of the perpendicular, and, under the action of gravity on the weight J^1 the rod immediately revolves on the pivot H^1 and swings round until it engages with the bent end L^1 of the rod L, forcing the latter back to the position shown by the full lines and allowing the lever arm B to rise again to the horizontal. The result is that the lug G can engage with a notch in the plate H arranged diametrically opposite to the notch with which the lug originally engaged, and thus prevent the rod J from flying back. Simultaneously the cord F is again gripped between D and E.

The machine which we examined was so adjusted that the time taken for the rod J to revolve sufficiently to knock back the lever L was half a second, and it will be realised that it is, consequently, just for that length of time that the cord F is free and hence that the weighted needle point presses on the surface of the material under test.



ARRANGEMENT OF HALL-MARRIOTT AUTOMATIC PENETROMETER

The time can be varied within limits, but into that question we need not enter.

In practice the sample table is first accurately levelled. A tin containing the material to be tested is then placed upon it, and the height of the table is adjusted until the point of the needle just touches the surface of the material. The reading of the pointer on the dial is then taken and the lever K depressed. Immediately, the rod J is released and begins to revolve, while simultaneously the cord F is freed and the needle commences to press into the material under test. As soon as the rod J has revolved sufficiently to strike the end L^1 of the lever L, the cord is gripped again so that the downward progress of the needle is arrested. The reading on the dial will then represent the penetration of the needle. We may say that on the occasion of our inspection we saw several tests made on the same material, and the readings in all cases agreed with remarkable accuracy. It is claimed, in fact, that the exactitude of the timing mechanism is such as has never been attained before in an apparatus of the character of that described above, and that, hence, an extremely accurate measure of the relative consistency of the materials tested can be obtained.

THE official report on the explosion of a Lancashire boiler at a Scottish colliery reveals a notable case of neglected corrosion. The boiler, which was about thirty years old, had a shell of ¼in. plating, and was exposed to the weather. It exploded at a pressure of some 62 lb. per square inch, and a boy was killed. Subsequent inspection revealed the fact that the lower part of the shell plating at the front of the boiler was wasted away over a large area, and that the thickness at the line of fracture was only ¼in.

A New Form of Air Filter.

THE air filter is an indispensable part of the present day turbo-generator, turbo-blower or air compressor installation, and much ingenuity is displayed in the later forms of air filters designed for use with the above-mentioned classes of power machinery.

Air filters may readily be grouped under two main headings, namely "dry" or "wet" filters, according as water is or is not used as a cleansing and settling medium. The dry filter is the older form. In it a series of filter cloths in pocket form is used to intercept the fine particles of dust in the air. Although still largely used, dry filters become somewhat bulky where large volumes of air have to be dealt with, and frequent attention must be given to the state of the filter cloths if efficient running over prolonged periods is to be maintained. The wet type of filter is of later introduction and is now made in a variety of forms, the best of which refute the objection, sometimes advanced against this type, that small particles of moisture are carried forward with the air, and are thrown down when the air reaches the inner part of the generator, to the detriment of the insulation.

An intermediate type of filter is the Visco air filter, which is in extended use on the Continent and has recently been introduced here by the Visco Engineering Company, Limited, of 82, Victoria-street, London. The filtering medium consists of an innumerable mass of short rings cut from very thin coppered steel tubing, which are coated with a thin film of a mineral oil termed "Viscinol." The special characteristics of this oil are that it possesses a very high flash point and is practically non-inflammable, and at high temperatures no vapours are given off. Its solidifying temperature is extremely low and the filtering action of the oil is not appreciably affected by frost. The filtering rings are contained in cells made in standard sections of about 20in. square and 3in. deep. The cell frame is stamped in one operation out of light steel and the back is provided with louvres which give the air an upward inclination. The front of the cell is covered with expanded metal. The cells are simply hooked on to a square steel frame, the design being such that any desired size or arrangement of filter can be built up from standard units.

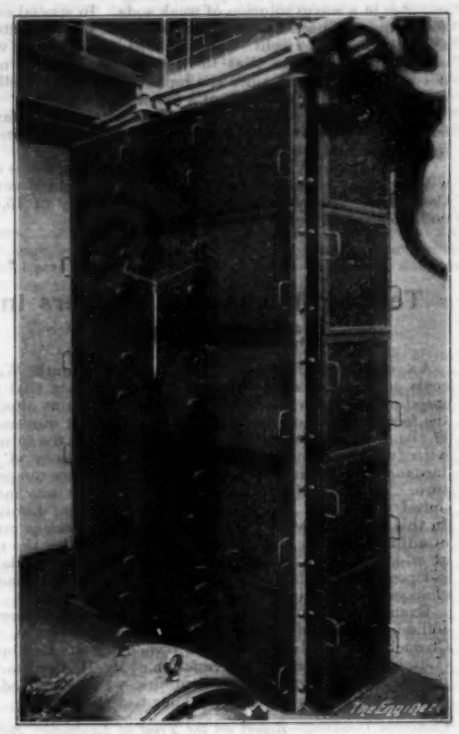


FIG. 1—A VISCO AIR FILTER

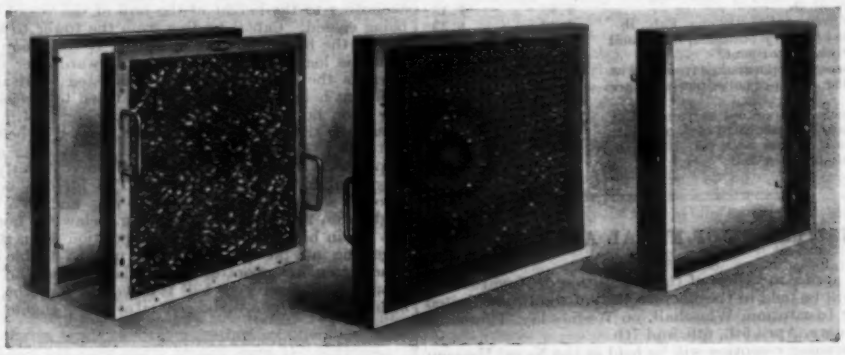


FIG. 2—VISCO FILTER CELL, SHOWING FRONT AND BACK, ALSO FRAME

The filtering rings, which are about $^{7}/_{16}$in. diameter and ½in. long, lie quite irregularly in the cell, and the ring mass offers a very large surface to the entering air. The actual surface represented by one cubic foot of rings is about 300 square feet, and the filtering quality of this surface is greatly increased by the sticky oil film with which it is covered. The average resistance through the cell varies

between 4 mm. and 8 mm. water gauge, according to the time the cell has been in use. As the average velocity of the air through the apparatus does not exceed 3ft. per second there is no possibility of oil particles being carried forward with the air current. Tests made with the "Visco" filter show that the dust content of the air is reduced to 0.3 to 0.4 milligrammes per cubic metre of air. Trials carried out at the Zschornewitz power station with extremely foul air having a dust content of over 3.77 milligrammes per cubic metre showed that this figure was reduced to 0.353 milligrammes.

The cells are cleaned by immersing them for a few minutes in a warm solution of weak soda. In special cases steam may be used to assist the process. We understand that about 10 per cent. of spare cells are supplied with each installation and that the service of the filter need never be interrupted, since the replacing of a dirty cell by a clean cell is only a matter of a few seconds.

After cleaning, which may be done at the attendant's leisure, the cells are recoated with "Viscinol" by simple immersion, and are then ready for further use.

We illustrate a Visco filter cell along with its frame and a Visco filter installation supplied to the Fulham Borough Council electricity works, having a capacity of 15,000 cubic feet of air per minute.

Test of Mechanical Stokers in South Wales.

An original difficulty in dealing with South Wales coals on mechanical stokers arose from the fact that the speed of the grate could not be changed without altering the feed. As is now well known, the speed of movement of the grate relative to the timing in feeding the furnace with fuel has a marked effect upon the efficiency of the furnace, the cleaning of the grate and the furnace temperature. To meet this condition, a new furnace was introduced some time ago by Ed. Bennis and Co., Limited. In this stoker provision is made for an independent range of adjustments for the speed of the grate and for the rate at which the fuel is fed, so that they can be regulated independently. The result is that the stoker can be readily changed to suit any kind of fuel.

Examples are to be found in several of the largest collieries in South Wales, among other places at the Clydach Vale Colliery, which is owned by the Cambrian Combine, and by the kind permission of Mr. Hedley Clarke, the general manager of the Combine, we are enabled to publish the figures of a twenty-hour test:—

Cambrian Combine.—Report on the Trial of Lancashire Boiler, 9ft. by 30ft., installed at the Cambrian Collieries, Limited, Clydach Vale. The boiler is fitted with a Bennis sprinkler stoker and self-cleaning compressed air furnace (South Wales types), and the test was comparative between the Bennis stoker and hand firing.

	System of firing. Hand.	Bennis machine stoker.
Duration of test, hours	24	24
Grate area, sq. ft.	44	46
Draught	Natural	Natural
Draught over fires, inches	.3	.3
Draught leaving boiler, inches	.6	.6
CO_2 in gases leaving boiler, per cent.	11.15	12.31
Temperature of feed water entering boiler, deg. Fah.	190.8	191.84
Steam pressure by gauge, lb. per sq. in.	136.4	144.7
Number of degrees superheat, deg. Fah.	120.23	139.08
Factor of equivalent evaporation as from and at 212 deg. Fah., including superheater	1.1348	—
Name of coal	Cambrian small	Cambrian small
Coal burnt per boiler per hour, lb.	982.3	1,446.7
Coal burnt per sq. ft. of grate area per hour, lb.	22.33	31.45
Water evaporated per boiler per hour—		
Actual, lb.	5,554	10,390
As from and at 212 deg. Fah., lb.	6,303	11,900
Water evaporated per lb. of coal—		
Actual, lb.	5.65	7.18
As from and at 212 deg. Fah., lb.	6.42	8.23
Thermal efficiency obtained, boiler and superheater, per cent.	53.5	66.77
Extra water evaporated as from and at 212 deg. Fah. per boiler per hour, per cent.	—	88.8
Extra water evaporated as from and at 212 deg. Fah. per lb. of coal, per cent.	—	28.2
Reduction in fuel cost per 10,000 lb. evaporated, per cent.	—	22.00

INSTITUTION OF NAVAL ARCHITECTS.

The spring meetings of the Institution of Naval Architects will be held in the Lecture Hall of the Royal United Service Institution, Whitehall, on Wednesday, Thursday, and Friday, April 5th, 6th, and 7th.

An evening reception will be held in the Naval Museum of the Royal United Service Institution on Tuesday evening, April 4th, at 9 p.m. The President, his Grace the Duke of Northumberland, will receive the guests.

The annual dinner of the Institution will be held on Wednesday, April 5th, at 7.30 p.m., in the Grand Hall of the Connaught Rooms.

PROGRAMME OF PROCEEDINGS.

Wednesday, April 5th.—Morning meeting at 11 a.m. (1) Annual report of Council. (2) Resolution relating to the establishment of a Benevolent Fund. (3) Election of President, officers and Council. (4) Presentation of the Institution Premium. (5) Address by the President (his Grace the Duke of Northumberland, C.B.E., M.V.O.). Sir Westcott Abell, K.B.E., M. Eng., Member of Council: "Merchant Shipping and World Commerce in Relation to Sea Power." Mr. J. H. Narbeth, C.B.E., M.V.O., Member: "Three Steps in Naval Construction—King Edward VII.—Lord Nelson—Dreadnought." Afternoon meeting at 3 p.m. Mr. J. L. Kent, Member: "Resistance of Ships among Waves."

Thursday, April 6th.—Morning meeting at 11 a.m. Dr. J. H. Smith, Visitor: "Nodal Arrangements of Geared Drives." Mr. J. Wilkie, Associate Member: "Double-reduction Gears in the s.s. Melmore Head." Mr. T. C. Tobin, M.A. Member,: "A Method of Determining the Natural Periods of Vibration of Ships." Afternoon meeting at 3 p.m. Mr. John Reid, Member: "Possibilities of Fuel Economy in Marine Boilers." Mr. J. L. Hodgson, Visitor: "The Metering of Steam." Evening meeting at 8 p.m. Mr. James Richardson, B.Sc., Member: "Diesel Machinery for Single-screw Motor Ships."

Friday, April 7th.—Morning meeting at 11 a.m. (1) Election of new members, associate members, associates and students. (2) Appointment of scrutineers for the next annual meeting. Mr. E. L. Champness, M.B.E., M.Sc., Associate Member: "Longitudinal Strength of Cargo Vessels and its Variation with Fullness of Form." Professor C. E. Inglis, M.A., Associate: "Some Special Cases of Two-dimensional Stress or Strain." Mr. John Tutin, Student: "The Economic Efficiency of Merchant Ships." Afternoon meeting at 3 p.m. Mr. J. Rennie Barnett, O.B.E., Member: "Recent Developments in Motor Lifeboats."

Summer Meeting in Paris, July 4th, 5th, and 6th, 1922.—The Council is arranging to hold a summer meeting of the Institution in Paris next July, particulars of which will be issued in May.

DUPLICATION OF RAILWAYS IN BRAZIL.

By Official Decree, the Brazilian Executive Authority has been authorised to open at the Ministry of Ways and Public Works a special credit of 4,700,000 milreis—approximately £155,000 at present rate of exchange—for the duplication of certain lines of the Central Brazil and North-Western Brazil railways. The amount is to be allocated as follows:—(1) 3,000,000 milreis for the conclusion of the work of duplication on the Central Brazil Railway between Norte and Mogy das Cruzes, a distance of 49 kiloms.; (2) 1,000,000 milreis for the duplication of the line between the stations of Bangu and Santa Cruz, a distance of 23½ kiloms.; (3) 700,000 milreis for the branch of the North-Western Brazil Railway from Lauro Muller to a point in the watershed of the rivers Feio and Tiberica most convenient to the North-Western Railway from the point of view of traffic receipts. Lauro Muller is on the North-Western Railway, in the State of Sao Paulo. Both the Central and North-Western railways are administered by the Federal Government. Calls for tenders have not yet been made, but in view of the importance of the projected work, the Commercial Secretary to the British Embassy at Rio de Janeiro has thought it advisable to forward the above information, in order that those interested might be able to take the necessary preliminary steps. The official addresses of the two railway companies concerned are as follows:—(1) Estrada de Ferro Noroeste do Brazil, Rua Sao Bento 14, Sao Paulo, Brazil; (2) The Central of Brazil Railway, Praca Republica, Rio de Janeiro, Brazil.

Since, however, both are administered by the Federal Government, it is suggested that communications on the subject might be addressed direct as follows:—Inspectoria Federal das Estradas, Praca Mana 10, Rio de Janeiro, Brazil.

AN AMERICAN MACHINE FOR COALING SHIPS.

For the delivery of bunker coal and cargo coal to steamers without the use of the steamer's own equipment, self-unloading coal barges have been installed at Galveston. These barges are open, and the hold is of hopper shape, with sides and ends sloping toward the keel. At the extreme stern is an engine-room compartment, with deck house. At the forward end is a tall steel tower, within which slides a frame carrying a hopper which feeds a belt conveyor on a steel jib pivoted to this frame. The head of the jib is supported and adjusted by lines from the head of the tower, and the frame is raised or lowered according to the height of the hull of the vessel which is being coaled. Cables leading from the tower to the after end of the hopper or hull operate a 1½-ton scoop bucket, which is loaded by being hauled forward over the coal towards the tower. There it is hoisted vertically to a sufficient height to enable it to be tilted to discharge into the 5-ton hopper. From this hopper the coal flows in a stream to the lower end of a 24in. conveyor belt on the 50ft. jib. The upper end of this jib extends over the ship's deck so that the coal is delivered directly to the cargo hatch or bunker hatch. The jib can be swung through a horizontal angle of 180 deg. and at a working angle from 20 deg. above to 15 deg. below the horizontal, but it can be raised to a vertical position when the barge is getting into position or is not in use. A double-cylinder winding engine operates the bucket cables and the jib hoist, but the conveyor belt is driven by a motor, current being supplied by a turbo-generator in the engine-room.

THE ROYAL SANITARY INSTITUTE: HENRY SAXON SNELL PRIZE.—The Henry Saxon Snell Prize was founded to encourage improvements in the construction or adaptation of sanitary appliances, and is awarded by the Council of the Royal Sanitary Institute at intervals of three years, the funds being provided by the legacy left by the late Mr. Henry Saxon Snell, Fellow of the Institute. The Prize this year will consist of fifty guineas and the Medal of the Institute, and is offered for an essay on "Improvements in the Sanitary Appliances and Fittings for New Housing Schemes, having regard to Efficiency and Economy." The essay should consist of not more than 5000 words, must be typewritten on foolscap, one side only, and be illustrated by drawings or sketches. Two competitors may combine in sending in an essay and drawings. The essays must be delivered on or before August 31st, 1922, addressed to the Secretary of the Royal Sanitary Institute, 90, Buckingham Palace-road, London, S.W. 1. Should none of the essays be considered of sufficient merit or importance to deserve the prize offered, the Council reserves the right of withholding the award, and in the event of two essays being of equal merit, the prize may be divided. The essay or essays to which the prize is awarded are to become the property of the Institute. Further particulars may be obtained on application to Mr. E. White Wallis, secretary, the Royal Sanitary Institute, 90, Buckingham Palace-road, London, S.W. 1.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Midland Lock-out Position.

Up to the time of writing no works in the Birmingham area have been compelled to close down in consequence of the engineering lock-out. The employers declare that, so far, they have experienced no great difficulty in carrying on with the labour available; but, on the other hand, it is conceded that a prolonged stoppage would undoubtedly have a serious effect upon industry generally. The members of the allied unions, it is stated, have suffered but little from the effects of the lock-out. A.E.U. officials declare themselves quite satisfied with the attitude of their members, who, they state, are still determined to stand firm. There is little on which to make a forecast of the future course of events, but the hopeful phase in both cases is that active steps are being pursued to restore peace. When the result of the ballot of the other unions on the employers' memorandum is known immediate developments are anticipated, either in the direction of peace or in an extension of the dispute. The cause of peace, it would appear, has not been advanced by Monday's discussion in the House of Commons; but the opinion in industrial circles in Birmingham is that the obvious way to settle the dispute is to meet and thrash out, as Sir Allan Smith suggested, the method of application of a principle which has been once conceded. This principle, I should say, among the vast majority of the men, remains virtually unchallenged to this day. What ought to be possible is to define more accurately the scope of the responsibilities which the employers must continue to exercise without let or hindrance. The first step towards a settlement of the dispute will be taken, I venture to suggest, when the dispute itself gets back out of the sphere of abstract principles into that of negotiation about matters of daily workshop practice.

Effect on the Iron and Steel Market.

In no direction has output been perceptibly affected during the week by the crisis in the engineering trades, so far as the iron and steel industry of the Midlands is concerned. This is due partly to the quietude which has prevailed so long and partly to the fact that many branches which depend upon engineering are running temporarily under their own momentum. A good proportion of the mechanics and skilled engineers engaged at the local ironworks are connected with unions which for the present have postponed actual hostilities pending the result of the second ballot. If the lock-out eventually extends to them, then the iron and steel trades will be more directly affected. Grievous injury has, however, been done, for an industrial rupture at this time is a serious blow to confidence.

Staffordshire Iron Trade and the Stoppage.

A prolonged stoppage in the engineering industry will soon affect the marked bar mills of the Staffordshire iron trade, for a lot of their products are used for high-class engineering work. Moreover, it will mean a lessening in the turnover of finished material generally, with a consequent increase of production costs at a time when a low price is the great desideratum in order to bring about a revival in trade. Consequently the developments are being keenly watched by Staffordshire ironmasters. Present selling rates for iron do not cover bare costs, but manufacturers are making the sacrifice in the hope of restoring the markets and receiving their compensation in an increased demand. Unless they can get a bigger turnover producers cannot afford to maintain the fight. Only a partial stoppage in the engineering trades means a serious depletion of the turnover, making iron more costly to produce at a juncture when everything depends upon getting prices down. Even to-day's quoted prices, it is stated, do not appeal to the consumer, particularly as all iron prices are now very much higher than those of mild steel, which can be utilised for a variety of purposes. In view of the anxiety of mills as to the placing of their output, consumers are this week able to exact easier terms, though late prices cannot have been remunerative. Unmarked bars of nut and bolt quality have fallen a further 5s. per ton, buyers having obtained supplies this week at £10 10s. per ton for good orders. Even for fencing iron £10 15s. is a rare figure, good lines being now accepted at £10 12s. 6d. Some makers, however, are endeavouring to get £10 15s. Though Belgian bar iron can be bought at £9 10s. delivered here, a price substantially below that of home producers, nearly all the business is going to Staffordshire and Lancashire firms chiefly because of the uncertainty as to when delivery of imported material can be obtained. Iron tube strip is finding but a poor market at £12 10s., steel material at £2 5s. less taking preference.

The Steel Situation.

In the steel department experiences vary. Some merchants have had a regular run of business for weeks past in steel sheets, bars, angles and light constructional material. Others, again, describe the position as almost stagnant. Prices remain firm and it is reported here that some of the Welsh works have three months' work in hand. A sign regarded very hopefully is the general rise in export values of steel. English steel makers have been obliged to give substantial preferential concessions to secure a footing in the foreign market, and it has been quite common for steel to be sold to foreigners at quite £1 per ton cheaper than to home buyers. The English steel makers have now put up their prices several shillings per ton, largely on account of the rise in continental prices. Tonnages ordered are not yet large, though they show an appreciable improvement on those of a month ago. The trouble in South Africa has shut down steel business with that colony, which a short time ago looked rather promising. Political disturbances, apparently, are connected also with a noticeable falling off of business with India. Constructional engineers in this district continue

to report more inquiries. Small steel bars are now generally quoted at £9. An item of interest to this district is that a new electrically driven mill for the rolling of steel hoops and strip is ready to start at the works of J. B. and S. Lees, Limited, West Bromwich. It will give a range of sizes from ¾ to 8½ by 20 gauge, according to width. After an interval of some weeks continental steel makers are again sounding the market with offers of steel. One firm quotes £7 12s. 6d. for angles, f.o.b. Antwerp, and another offers steel joists at £7 14s. 6d. at the same port. When the cost of transport is added the material could be got here at well below home prices. For steel bars the offers are not likely to be acceptable on the score of price, and so much trouble has been experienced in the past over deliveries that British merchants and consumers will require strong price attractions before reopening this class of business.

Wire.

Steel wire rods maintain their strength. Very few orders have gone abroad latterly, the home price, £11 10s., leaving no advantage to the foreigner, while, in addition, home makers are able to give prompt delivery. If the volume of business is not large it is coming along with fair regularity, price reductions having stabilised the finished wire trade. Bedstead angles are selling slowly at £10 to £10 5s.

Firmer Pig Iron Values.

The market for pig iron has undoubtedly become firmer following rising coke values, and some smelters are again endeavouring, though without much success, to get higher prices. The effect of the engineering trouble appears to be restricted so far to the suspension of certain negotiations for the purchase of foundry material, the consumers preferring to wait and see the result of the lock-out. But, on the other hand, a fair tonnage of business in foundry iron has passed, shrewd buyers concluding that the present is a very favourable time for making contracts while inquiries are practically continuous. In view of the unprofitable character of pig iron production, few blast-furnace owners are cultivating large contracts, and a number of the latter have been cut down in quantity. Plants are not producing up to half their capacity and unemployment is distressingly prevalent, not in Staffordshire alone, but in practically every centre of the trade throughout the country. It is interesting to note that, though eleven additional blast-furnaces were re-lighted last month in the kingdom as a whole, the total in blast is only just over one hundred out of a total of nearly five hundred. Still, the position has been steadily improving, and more pig iron was produced last month, the shortest of the year, than in any month since the coal strike paralysed the trade now nearly a year ago. The great weakness of the Scotch market is regarded as a menace to Midland prices. Among the recent contracts made by Midland smelters are fairly good quantities for export, a branch of trade in which the Midland districts are now able to compete successfully with Cleveland. An interesting development is the reopening of the Glasgow warrant market, apparently in anticipation of pig iron stocks, as the basis of the kind of speculation which was formerly a feature of the pig iron business. But until many more blast-furnaces are put into operation there will not be much pig iron to deal with in this way. There is no quotable change in values this week. They are:—Northamptonshire forge, 70s. to 72s. 6d.; foundry, 80s.; Derbyshire forge, 72s. 6d. to 75s.; No. 3 foundry, 82s. 6d. to 85s. at furnaces.

Coke Prices.

There has been some easing of coke prices this week, pressure for deliveries on the Continent not having been maintained. Blast-furnaces are now able to get supplies at about 18s. 6d. per ton. Where prices have been stimulated of late it has applied more particularly to furnace cokes used in substitution for gas coke. The latter is now quoted at 37s. 6d. to 38s. 6d. The coke maker gets rather better prices for his fuel sold abroad, and naturally cultivates this business. There are complaints from home consumers of poor supplies and delay in deliveries.

Galvanised Sheets.

Galvanised sheet makers are able to continue in operation at the mills already started, but the position in the industry does not favour the re-starting of additional plant. There is only a quiet inquiry owing to the hesitancy which some of the principal markets overseas are showing, and values rule rather easier. The industrial disturbances in South Africa have put an end to business with that market for the time being. India and Australia are operating very cautiously, while little support is forthcoming from South America. Mills are not inclined to force the pace at the expense of prices, however, quotations ranging from £16 to £16 5s.

Novelty in the Birmingham Brass Trades.

In the Birmingham brass trades there is just now a very interesting novelty in the production of water fittings. One or two Birmingham firms are now making taps entirely from stampings, instead of casting them, as has been the usual practice. It is claimed that besides cheapening the manufacture, the stamping process gives a tap which is quite impervious to water pressure. The possibilities of hot stampings in the brass trade were not realised till munition work in the war opened up a new field. Since then there has been a notable extension of the process in displacement of casting. Many tons of brass are now either stamped or drawn where formerly they would have been cast. Innumerable articles of heavy cabinet brassfoundry are now stamped and spun. They involve less skilled labour and less cost, inasmuch as most of them are simply pressed in machines by women instead of beign cast and dressed by men.

Difficulties of Pits in Warwickshire.

Following upon the difficulties experienced by the management of the Nuneaton collieries, recorded by me a few weeks ago, comes the news that a grave state of affairs has arisen at Pooley Hall and Tamworth pits. Unless some arrangements can be come to whereby the collieries can be carried on at a less cost a stoppage of both pits is feared. It is stated that the management find it impossible to make the pits pay under the existing conditions. Matters have been brought to a head during the past week or so, the employers having asked the colliers to accept a 20 per cent. reduction below the district rate of wages. The men state that it is impossible for them to accept this reduction, but their officials are doing everything they can to come to some arrangement. About 2500 workers are affected at both collieries, and practically the whole village of Polesworth and other districts are dependent upon the two pits.

Obituary.

Again this week I have to record the passing of one of the leading industrialists of the Midlands. Mr. John Green, who died on the 16th at Stourbridge, was one of the pioneers in the anchor and cable trade in the Old Hill district of the Black Country. He founded a business there about fifty years ago, and only retired from active association with it when about eighty years old. He will be much missed in Midland engineering and industrial circles.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel, and Metals.

THE general position in the iron and metal trades does not show any definite change. So far as one can see, most of the buying of iron and metals is now in abeyance, and people in the trade are waiting for further developments. The two questions of interest are, of course, whether or not the lock-out is to be a long affair or whether the spread of the trouble to the shipbuilding and iron-foundry trades can be avoided. Until we have some definite knowledge on these two matters, it is impossible to form any idea as to the course of the markets. The general condition of trade in the country is so bad that no doubt every effort will be made by the leaders on both sides to bring about a settlement.

Metals.

The market here for copper remains very quiet, and there has been no important change in the quotations. Only a very small business is now being done, but the diminution of Manchester business was, of course, inevitable when the engineering lock-out was decided upon. The loss of new business does not affect prices, as it would do if there were much margin for a fall, but it postpones the time of recovery, and one cannot now expect higher prices until the engineering demand begins again. It is generally understood that consumers in this district have no reserve of copper, and hence when they are able to use it again there may easily be a spurt in buying; so that from a market point of view a good deal depends upon whether the stoppage is to be long or short. The position in America seems to be fairly steady at the moment; but there are rumours of a possible coal strike in that country which might possibly check the domestic consumption for a time. The setback in the Exchange, however, helps to prevent the offering of cheaper American copper for shipment to Great Britain. The general feeling in the market does not favour the idea of higher prices for copper in the near future, but, of course, it does not do to ignore the fact that the present level of prices is very low. There has been no change in the official prices for manufactured copper and brass, but, of course, there is very little demand. The market for tin has been keeping fairly steady at what is generally considered to be a low level of values. Tin has, however, been very much lower than at present, and that in normal times, and so far as the statistical position is concerned, probably the condition of tin is rather worse than that of copper. There is a great quantity of tin still waiting in the background, although we have been promised by the principal holders—the Federated Malay States Government—that there will be no attempt to throw it on the market. It is, however, not without its influence on sentiment. The actual demand for tin seems to be smaller, both here and on the Continent, but according to general market opinion there is no immediate prospect of any serious movement in the prices. There seems, however, to be a doubt whether, in view of the rather full supplies of the metal, the present level of prices can be maintained over any long period. Spelter has been rather a better market lately, and the British galvanising works seem more inclined to augment their stocks. They have adopted a hand-to-mouth system of buying for some time, but many now think that this system has had its day, and that it is no longer quite safe to work the galvanising trade without an adequate stock of spelter. The Continent does not offer much metal, and the drop in the exchange with America tends to discourage further offers from that side. Lead has been fairly steady since the beginning of the month. The home consumption of lead seems now to be rather on the low side.

Pig Iron.

The demand here for foundry iron is again smaller this week, and that is, of course, inevitable, now that the engineering firms are no longer calling for castings. The ironfoundries of Lancashire have some work in hand, and there are occasional orders for foundry pig, but the amount of work in reserve is steadily growing less. This might not have so direct an effect on the buying of foundry pig were it not for the fact that as a general rule the Lancashire foundrymen have no confidence in the stability of pig iron prices. In spite of the fact that most makers of pig iron are now asking a price which barely covers the cost of making, foundrymen are of opinion that the prices have yet to come down, and hence, of course, will not buy except for prompt consumption. This kind of consumption threatens to come to an end in many of our foundries unless the engineering dispute is soon settled. There has been no change in prices here, which remain at 92s 6d. to 95s. per ton for common No. 3, and 117s. 6d. to 120s. for Scotch No. 3 delivered in Manchester. East Coast hematite is perhaps a little easier, but there is little demand for it here. For forge pig iron there seems to be no market at present. The idea of prices seems to be based on 70s. or perhaps 72s. 6d. per ton on trucks; at any rate, that is the idea of consumers.

Steel.

The condition of the market here for finished steel is, if anything, worse than that for pig iron. The official prices are unaltered, but merchants and makers' agents appear to be doing nothing. It is said that there is a fair demand for export, but only at prices which leave a serious loss. Steel manufacturers may take some of these export orders with a view to keep the works going until the home demand revives; but the cessation of the home demand is a very serious matter at a time when about half the capacity was unemployed before the lock-out began.

Scrap.

There is practically nothing being done in the scrap market at present, but dealers do not make any change in the nominal prices, which are 45s. per ton for steel scrap, 60s. per ton for wrought iron scrap, and 80s. to 95s. according to quality for cast iron scrap.

The Lock-out.

Pending the result of the ballot which is now being taken by the three trade unions secondarily involved in the present unfortunate dispute, it is impossible to predict what is going to happen or how long the deadlock will last, but employers in the Federation in this district to whom I have spoken seem quite satisfied with the manner in which Sir Allan Smith stated their case in the House of Commons on Monday night, and especially is this true with regard to Government intervention. The tone of Sir Allan Smith's speech in the House of Commons is thought to have compared very favourably with that of the leader of the Labour Party, and was not nearly so aggressive. His suggestion to the members of the unions that are now balloting that if they were prepared to agree with the employers in principle with regard to the employers' rights to manage their works, the employers would be willing confer with the unions as to the manner in which the managerial functions are to operate, showed a spirit of reasonableness and willingness to negotiate which is generally commended. I feel sure that three-fourths of the members of the A.E.U. would be quite satisfied to resume work on such a common-sense basis, if it could only be brought to their notice, and if the secrecy of the ballot was assured. There is, however, a common complaint in these parts that the men who form the sober element in the A.E.U. do not make use of the ballot, while the extremists, who are really in a minority, vote solidly in all matters affecting their relationship between the employers and the men. So far as the lock-out has extended, there has been no display of ill-feeling in this district, and I hear of no serious attempt at picketing the various works. If the present good temper is maintained, the end of the unfortunate affair may not be long delayed.

The Cotton Trade.

Although there was a failure of one large firm engaged in the textile industry in Manchester recently, from statistics collected by the International Federation of Master Cotton Spinners' and Manufacturers' Associations, it would appear that for the six months up to the end of January, at any rate, the cotton trade was showing distinct signs of improvement as compared with the preceding six months. Summarised, these statistics show that 683 firms, owning 51,162,519 spindles, curtailed production on 32,204,981 spindles during the half year to the extent of 460,518 hours. This stoppage calculated over the whole industry means an entire suspension during 6.039 weeks, against 12.92 weeks in the previous half-year and 6.04 weeks in the half-year ended January 31st, 1921. The fact that the position with regard to the cotton trade of this country appears to compare favourably with that of other countries, should give some slight consolation to those engaged in the industry.

BARROW-IN-FURNESS, Thursday.

Iron.

If there is no settlement of the engineering dispute before long, there is sure to be a reduction in production. The position to-day is that while certain customers are stopping deliveries, others, in view of the present price of mixed Bessemer numbers, may stock it pending a re-start. In the meantime, the steel works are large consumers of iron, and in view of this fact the present number of furnaces may continue in blast for a time, but if, on the other hand, the trouble continues and extends, then there will be some damping down at most works. There is not the same life in the markets as there has been. Given a freedom from labour troubles, and a possible reduction in labour costs, there would be a steady improvement in the demand. Small cargoes are being dispatched from this port to Antwerp now and then.

Iron Ore.

The iron ore trade is very quiet, and there are no mines working at anything like their full strength. It is not anticipated that there will be much change for the better for a long period. None of the mines are working full time or are employing a full complement of men. The trade in foreign ore is not heavy, and cargoes are arriving at long intervals. Some foreign ore has been stocked, and is now being reduced.

Steel.

The steel trade continues on unaltered lines. The Barrow rail mills are at work, as also are the hoop mills, and in connection with the latter there are exten-

sions in other branches of steel manufacture that will add very considerably to the activity of that branch. In other parts of the district the steel works are engaged upon various classes of steel. The demand is not heavy, but there is limited work for some time. Rails were shipped from Barrow to Colombo and Lagos last week.

SHEFFIELD.

(From our own Correspondent.)

Working Full Time.

Although it must unfortunately be admitted an exceptional instance, it is gratifying to find, at any rate, one local firm that is working, not only full time, but a twenty-four-hour day for seven days a week. This, at any rate, is the experience in a number of their departments which Messrs. Spear and Jackson are able to report, and on a recent visit I found abundant evidence in support of this claim. This firm, it is scarcely necessary to explain, specialises in saws of all kinds and in spades, shovels and forks, and its present spell of activity—which is indeed rather more than a "spell," for it dates back almost from the cessation of war-time work—is not confined to any single department. The firm has, in fact, the almost unique distinction of having found employment recently for additional men, instead of having to reduce their number or their hours. What is still more gratifying is the fact, as stated to me by one of the directors, that much of this business has been captured from the Americans. Perhaps one secret of Messrs. Spear and Jackson's present activity is that they have for some time past been trying to break away from the traditional British way of supplying only what they think their customers want, instead of meeting their customers' own requirements. They have been sending into all parts of the world to investigate actual conditions and requirements, and to a large extent regard their representatives as investigators rather than merely salesmen.

Seeking Work for Sheffield.

The Lord Mayor of Sheffield, together with representatives of other armament centres which were badly hit by the results of the Washington Conference, recently had an interview with the First Lord of the Admiralty, the Chancellor of the Exchequer and other members of the Government. They presented a very strong case for special consideration, and urged that orders for the two capital ships which were to be built in place of the four battleships should be put in hand as soon as possible; they also urged that colonial Governments should be encouraged to place their orders or contracts in this country, seeing that they often raise their capital here, and that the Overseas Trade Departments should facilitate the construction of railways and other works and plants which would assist the steel trade. The First Lord of the Admiralty promised to consider the possibility of expediting the orders for the two new capital ships, and to pass on the suggestions respecting orders from the Colonies. The Lord Mayor returned to Sheffield very hopeful that the result of his representations would prove of advantage to the city. In the case of Sheffield, of course, it is more a matter of guns and armour than of actual shipbuilding, and these could be manufactured in advance of the actual construction of the ships. How far this can be done without disturbing the plans of the Chancellor of the Exchequer is a problem which the Departments concerned are confronted with.

Looking Ahead.

At the moment, of course, the engineering trouble precludes the possibility of any revival of business; but everything possible is being done to prepare for it as soon as the turn comes. The Sheffield Corporation, for instance, has made a further reduction in its electricity charges, which, in effect, will mean that one-half of the maximum increase imposed as a result of the war will have been swept away. This is the third reduction in nine months. The declared object of the electric supply department is to encourage increased consumption, and enable firms to cheapen production, lay down new machinery, and thus create employment. Another helpful factor is a noticeable stabilisation of prices. Reductions in iron and steel material would seem to have almost come to an end, and buyers are beginning to realise that they have little or nothing to gain by holding off the market or by placing orders abroad. The drop in prices has been more conspicuous in the Swedish than in the home market, probably because quotations for Swedish material soared to greater heights than British material during the war. There have been recent quotations of £25 for Swedish Bessemer billets, which at one time were more than £50. Swedish grey pig is now down at £9 10s., compared to £30 during the war, and bar iron has dropped from £60 to £20. Two important materials can now be bought at less than pre-war values. One of them is steel scrap, the local price of which is from 50s. to 55s. per ton, whereas similar material was worth about £3 15s. in 1914. Tungsten powder is being sold as low as 1s. 6d. per lb., compared with a pre-war average of from 2s. 3d. to 3s., while it exceeded 6s. during the war. Coke for melting crucible steel has lately been reduced 10s., the quotation for beehive quality being 37s., and patent quality 27s. per ton. The highest recorded prices for the former were between 70s. and 80s.

Value of Nickel Alloys.

The utility of nickel alloys in certain branches of engineering was the subject of an interesting paper read before the Sheffield Section of the Institute of Metals. The author, Mr. W. R. Barclay, who formerly held an important position in connection with Sheffield University, said these alloys of nickel had considerable value in modern engineering, because they possessed the property of retaining their tensile strength at temperatures very much over the normal, and appreciably higher than was the case with other non-ferrous alloys. This factor was of very great value in view of the requirements of modern engineers for materials to work under superheated steam, and generally at temperatures higher than 350 deg. to 400 deg. This property of resisting heat was also combined with resistance to electricity, and therefore rendered these alloys very valuable materials for electrical resistances. Nickel alloys were also, in general, superior to other non-ferrous alloys in their power to resist corrosion. Among the alloys of nickel which might be said to stand out pre-eminently were those of nickel and copper, which contained between 40 and 65 per cent. of nickel; alloys of nickel and chromium; alloys of the latter class which contained iron; and certain others. The alloys of copper and nickel which had been referred to in the Press, with reference to their stainless properties, were by no means new. They were amongst the oldest alloys known to civilisation. Distinct evidence was in existence that copper-nickel alloys were used for coins and tokens as early as 233 B.C. The general conclusion with regard to these alloys was that very considerable progress was being made, and it was likely that in the near future materials might be produced which possessed an exceedingly high degree of resistance to stain, tarnish or corrosion generally. It could not, however, be truly said that that time was yet, and it was unfortunate that the public had been led to conclude that the problem had been entirely solved.

The Corrosion of Metals.

The corrosion of metals has also been discussed during the week by Dr. Rogers, one of Sheffield's best known investigators in metallurgical science and practice. Alluding to the famous ancient holy wrought iron pillar at Delhi, which is over 23ft. high and weighs 6 tons, he suggested that one reason why it never rusted might be the almost ceaseless slight sand-blasting action of the dust carried in the atmosphere. He made a laboratory investigation to study this action, which, he thought, he might be able to apply as a basis of a new test in the development of new steels and alloys for resisting corrosion under conditions obtaining in service.

A New Telephone Exchange.

Sheffield's new telephone exchange, which has been promised for years past, now seems within measurable distance of realisation. Work has been started on preparing the ground—a site in the centre of the city—for the foundations. The task of erecting and equipping the exchange will take a considerable time, and it is estimated that it will be three years before the city enjoys the full benefit of the new system, which, it is said, will embody some new and unique devices.

Fuels.

The inland demand for industrial fuels has, of course, fallen off very rapidly as a result of the engineering stoppage. At hard coal pits this falling off has been so marked as to necessitate short time working. The export demand is, however, on a fairly good scale, and increased shipments at the Humber ports are anticipated. In fact, there are already a large number of inquiries for forward business, and orders are being placed more readily than was the case a short time ago. The steam coal market is in a far better position than might have been expected. In spite of the falling off in inland demand, values remain steady, and no great change is likely until the wages ascertainment for February—on which April prices will be based—is known. There are, however, special lots offered at cut prices. The small fuel position is unchanged, though if short time continues, stocks will soon accumulate. Production of blast-furnace coke is slowly overtaking the demand. Export business is not so strong as a week or two ago, and values are weakening. Owners of the soft and deep hard pits in Derbyshire are no longer disposed to pay the same getting rates for soft coal as was done during the war, and have given notice of reductions, ranging from 6d. to 4½d. per shift, while in the case of boys under twenty-one the reduction will amount to 1s. 1d. The matter is being viewed with serious concern by the Derbyshire Miners' Association, and it is not likely that the cuts will be agreed to without strong resistance. The suitability and reliability of reinforced concrete for pit shaft lining, and for the construction of headgears, was advocated by Mr. T. Crosby, of Swinton Common Colliery, in a paper read before the Yorkshire Colliery Undermanagers' Association. The experiment, he said, was being watched with considerable interest, for the motion of the loaded cage and engines set up a certain oscillation. That and other factors set up a peculiar strain on materials of which headgears were built, and concrete experts and colliery engineers were very anxiously awaiting the results. In his own experience, the concrete lining of the shaft had proved entirely successful, and he recommended its use throughout the entire length of the shaft.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Gloomy Trade Situation.

The general trade situation in the North of England is very unsatisfactory, and prospects under the present disturbing circumstances must be described as gloomy and discouraging. The continuation of the dispute in the engineering industries, and the threatened stoppage in the shipyards are having their inevitable effect on other branches of industry. This labour upheaval is to be deeply regretted. A few weeks ago there were signs, definite, if few, of a trade revival, and if these troubles had not arisen there is no doubt that a progressive improvement in the trade position would have been experienced.

Cleveland Iron Trade.

Up to the present there has not been any tendency to arrest deliveries of pig iron under contract in consequence of the industrial disturbances, but the volume of new business has become appreciably smaller. Home buyers are not coming forward with the same degree of confidence. There is, however, a fair number of inquiries from abroad. The supply is hardly sufficient for current needs. Makers still complain that recognised market rates are unremunerative, and the only hope of rectifying this unfortunate position appears to be by a fall in the cost of production. Prospects in this direction, however, are not very encouraging. A blast-furnace at the Tees Ironworks is to be put out of operation at the end of this week, which will reduce the number of furnaces producing foundry iron to six. Thus there is not likely to be any surplus iron, and makers are adhering firmly to their recent prices. One of the obstacles to putting more furnaces into blast—apart from the high cost of production—is the prolongation of the bricklayers' strike. It is believed that this unfortunate dispute will need to be settled before the output of pig iron can be increased.

Hematite Pig Iron.

The relatively high price now ruling for East Coast hematite pig iron has had the effect of restricting business with the Continent. There is a good market both in Germany and in Italy for East Coast hematite, but prices are closely scrutinised, and the difference of a shilling or two may mean the loss of an order. Now that the second furnace is operating at the Seaton Carew Ironworks, and the output has been further increased, there may be keener competition for orders, and possibly a shading of the price. As yet, 100s. is kept as the general quotation of mixed numbers, but with a lull in buying makers are a little more inclined to seek business. There is, in fact, not quite the same difficulty in getting small lots of prompt iron, and possibly for a good order the 100s. quotation would already be shaded.

Iron-making Materials.

The foreign ore trade is rather more active, but the relatively high price of best Rubio ore, which is now 27s. per ton c.i.f. Tees and may go higher in consequence of the increase of the export duty from Spain on April 1st, tends to divert business to other channels. Most of the sales recently have been for North African ores, which range from 21s. to 22s. per ton, and several cargoes have changed hands, although business is still largely of a hand-to-mouth character. Some of the coke makers continue to quote 29s. for furnace coke, but for the better brands no difficulty is experienced in obtaining 30s. per ton delivered at the works, and the latter seems to be the standard price for good qualities.

Manufactured Iron and Steel.

The bricklayers' strike is seriously affecting the steel works, and grave difficulties are being experienced by the already harassed manufacturers. There seems to be just a trifle better tone in the market, but any inquiries that come forward are still for very small lots, which destroy all chance of producing at a profit. Whilst undercutting for foreign trade is by no means so keen as it has been, export business can still be put through at substantially less than home prices.

The Coal Trade.

The tone of the Northern coal market at the moment is exceedingly steady, and in spite of some rather pessimistic forecasts, the position has not deteriorated to any appreciable extent. The undertone, however, is not so strong, and there is an absence of stability and assurance respecting forward prospects and contracts, and commitments are approached with a degree of hesitation. There are on hand, and under consideration, a large number of foreign inquiries, including some for public utility services abroad. These are for gas coals chiefly, and, if placed, will tend to stiffen the gas coal market; but in view of the high figures now quoted, and the lower figures of some foreign trade rivals, the placing of orders is doubtful. In the meantime the collieries for the most part are well off for orders, and fully stemmed. They are not displaying any anxiety to commit themselves much further, while exporters are also not disposed to purchase very largely for future delivery. In their opinion the position is not sufficiently stable to allow of any speculative buying. There is a fair amount of business passing for prompt, but it is through second hands, who are able to obtain good prices for any holdings they possess. There is more than sufficient tonnage on offer, which makes the situation more satisfactory for the collieries. The steam coal trade is very brisk for every class, and business direct with the collieries is difficult, as they are sold out for prompt, while for any date before the end of April top values are exacted. Second steams, nuts, and all kinds of steam smalls, though heavily produced, are very steady. Gas coals of every kind are scarce, and unobtainable from the pits, the output being disposed of for the next few weeks. Coking coals are fairly steady, and bunkers retain all their recent firmness for any early date of shipment. The coke market has eased away, especially for foundries. Gas coke is steady.

SCOTLAND.

(From our own Correspondent.)

Pronounced Depression.

The crisis in the engineering trades has assisted to accentuate the depression in industrial circles. Traders everywhere are merely marking time at present, and general conditions are most unsatisfactory. As in the case of the coal strike last year, the present industrial strife has broken out just when there seemed a chance of conditions improving. A few weeks ago buyers became more active, and there seemed reason to expect better things soon. Now, however, the buying movement has come to an end, in the meantime, at least. The level of prices, of course, is partly responsible for the check to buying operations. Steel makers, generally, are maintaining quotations on a fairly high basis in spite of the dearth of business, contending that even at the prices charged a loss on production is inevitable. Consumers, on the other hand, maintain that in the face of cheaper wages, coal, and pig iron, makers ought to be able to grant

a substantial decrease in prices. In any case, whatever the reason, the little spurt in buying has died down, and consumers are again purchasing on the smallest possible scale. There is a lack of confidence in the markets, and neither producers nor consumers are inclined to take risks.

Glasgow Pig Iron "Ring" Re-opened.

In accordance with the decision reached a few weeks ago by the Committee of the Scotch Pig Iron Trade Association, the Glasgow Pig Iron Ring was re-opened last week. No warrants are in existence, and consequently prices were quoted for makers' iron. Cleveland No. 3 G.M.B. was quoted at 90s. each buyers and 95s. sellers three months. No business was done during a session of short duration.

Pig Iron Markets Idle.

Little or nothing is passing in the pig iron markets. Only very small lots are being bought on home account, and though the foreign inquiry is increasing, actual business is not resulting. The number of furnaces in blast is very small, but makers have difficulty in disposing of outputs, and in order to avoid additions to stock, prices of foundry qualities are being reduced. Hematite, meantime, is comparatively firm.

Finished Steel and Iron.

Business in the steel trade is seriously curtailed, and it is estimated that not more than 20 per cent. of the productive capacity of the works in the West of Scotland is in action. Plates and sectional material are extremely quiet, and makers find it increasingly difficult to do any business at all. The steel mills were doing fairly well for a time with export orders, but this source of demand is much quieter again. Galvanised sheets, too, are in poor request. Wrought iron and steel tubes are not securing much business, and there are few new orders for machinery. Small tools are doing fairly well. Malleable bars are practically lifeless. There is a small general and agricultural turnover, but orders are of little bulk, and works are poorly employed. The export side has not developed to any extent in any one department. Freights are easing, but the caution in buying has extended to foreign markets also. The Australian and New Zealand markets show a slight movement. Tubes, and fittings and sanitary ware are going in larger measure to South America. Inquiries from South Africa and the Far East are very meagre at present.

Coal.

A comparatively good general turnover was done during the past week. Conditions, however, only show improvement in the export branch. Home sales are very disappointing, and a considerable amount of price-cutting is going on for all descriptions of fuel. Industrial deliveries are very restricted, and railways and municipal undertakings are buying sparingly. House coal is in fair demand, and some consignments of fuel have been sent to the West of Scotland from Fifeshire mainly for domestic use. Householders are now buying at cheaper prices, fuel being obtainable at 1s. 9d. to 2s. 1d. per hundredweight, according to quantity and quality. Ten-hundredweight lots upwards of second quality coal can be bought at the former figure, and best qualities at the latter price. Single hundredweights range from 1s. 11d. to 2s. 3d. and 2s. 5d. per bag. Exports are on the increase, and if bigger supplies of steamers were available the returns would show a more decided improvement. Continental consumers are more active, and the Lothian collieries are booking good orders for all descriptions of fuel. Some good consignments have also been sent to the London market. Fifeshire collieries also are doing better, owing to a steadier flow of business from Baltic ports. Prices are irregular, but for the most part show an inclination towards easier values, though washed materials maintain their position. Aggregate shipments for the week amounted to 273,505 tons against 247,936 tons in the preceding week, and 334,147 tons in the same week in 1913.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Activity.

FOREIGN coal exports last week were not quite as good as those of the previous week, but allowing for the inevitable periodical variation which occurs in returns, the figures cannot be accepted otherwise than as satisfactory when all things are considered. The flow of tonnage and bad weather may be responsible for some diminution in the shipments accomplished, but in spite of the official figures it is noteworthy that at the Barry Docks the returns for last week created a record since the reduced working day came into operation, the total quantity of coal shipped being 203,589 tons. It follows, of course, that the work done at some of the other docks must have fallen off, but the fact that considerable quantities of coal have to be shipped is again proved by the heavy chartering of tonnage, which has taken place. Last week the improvement in chartering which has been in evidence of late was maintained, and no less than 130 steamers, representing a carrying capacity of close on 394,000 tons, were taken up by exporters to be loaded at the ports of Cardiff and Newport. One very noticeable feature about the exports recently has been the fact that Welsh coals are finding their way to all parts of the world, as in pre-war days. Still, at the same time there is a lull in the inquiry for coals in the case of Italy and France, as a result of the comparatively high prices for supplies from this district. In the case of Italy, the position is that shipments to that country have recently been very heavy, and there is a certain amount of congestion at the ports of discharge. The desire of the firms importing the cargoes to get quick clearance has resulted in a fall in the Italian market, and buyers are now offering a price which is below cost. Coals cannot be bought and shipped to West Italian ports at the figure, so it is easy to see that the demand for fresh cargoes is negligible. Still, despite the diminished inquiry the tone of the steam coal market here is firm, and coal-owners are very closely watching the course of events in the American coalfield, where labour troubles are expected to develop next month. At the most, the strike in the American coalfield will only be sectional, and it is rather difficult to say what the precise effect of it will be on this market, assuming it comes about. Coalowners here will almost certainly advance their prices, but, of course, it remains to be seen whether the general demand for coals from abroad increases to any appreciable extent It is interesting to note that one inquiry out of the ordinary has come along, this being for 6000 tons of Welsh steam coals per month for six months as from April, the destination being Montreal. These coals are required, it is understood, for consumption by liners, and it looks as if the inquiry is the result of fears respecting troubles in the American coalfield.

Docks Working Hours.

The suoject of working hours at the South Wales docks was discussed at Cardiff at the end of last week by the representatives of the Chambers of Commerce and the coalowners, together with the representatives of the coal trimmers and tippers, but very little headway was made. The proposal which came in for most discussion was that the present two shifts, from 6 a.m. to 2 p.m. and from 2 p.m. to 10 p.m., should be converted into nine-hour shifts, each less an hour for meals, leaving eight working hours, divided by an interval of four hours and two hours respectively The idea of this proposed change is to permit the better clearance of traffic and to increase the working efficiency of the docks by 20 per cent., this being the contention of the Dockowners' Association. Unfortunately, the representatives of labour were not enamoured with the scheme nor with the suggestion regarding the re-introduction of the third shift. Their view is that increased tipping appliances should be provided and dock improvements generally effected. This being their attitude, the whole question was referred to a joint sub-committee, which was due to meet this week in order to prepare a report for submission to a further conference.

Pit to Close.

At a time like the present, when the conditions in the steam coal trade are better than they have been this year, it has come with all the greater surprise that notices have been served upon the whole of the workmen, about 600, employed at the Lower Deep Colliery, Blaina, which is owned by Lancaster's Steam Coal Collieries, for which the sales agents are T. Beynon and Co., Limited. It is understood that the colliery is not a paying proposition. Since February of last year, all the large collieries at Blaina have been idle, with the exception of the Lower Deep Colliery and the North Blaina Colliery, the latter being now the only one to continue operations. Naturally there has been a good deal of distress in the district, and it has been stated on more than one occasion that 75 per cent. of the population has been in receipt of parish relief. It is not so long ago that the Minister of Mines, with representatives of the owners and the workmen met in conference in order to discuss ways and means of reopening the mines in that area. The company expressed itself as ready to adopt any reasonable suggestion, but the proposal which was put before it by the workmen was found to be unacceptable.

Current Business.

The steam coal market really shows no appreciable change as compared with a week ago. On paper the collieries are very fully sold, but, of course, if tonnage does not come up to time, it means that their loading arrangements are upset, and they cannot always get their wagons cleared. Even so, however, colliery salesmen are not inclined to make any material concessions so far as large coals are concerned, though small descriptions are not so steady, owing to there being larger quantities on the market as the result of the bigger production of coals generally. The price for best Admiralty large is 27s. 6d., and for second qualities 27s., and it is practically impossible to break these figures, whether for prompt or backward shipment. Colliery salesmen are very cautious regarding their commitments for delivery ahead, in view of the probabilities of trouble in the American coalfield, but in any event most concerns are very well off for orders, not only for the remainder of this month, but for next as well. It has to be remembered that in the case of April the Easter holidays have to be taken into calculation, which means that there will be a loss of output and less time in which to execute export deliveries. Monmouthshires keep a very steady tone, but best smalls are not worth more than 19s. 6d. at best. Patent fuel and coke and unchanged, but pitwood is rather steadier. Anthracite coals are on the quiet side, although some of the sized coals and rubbly culm and duff coals are rather scarce and a shade firmer.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

THE tin-plate outlook gives more promise in view of the inquiries circulating and the fact that stocks are becoming depleted. Prices show an improving tendency. Business at the moment is still comparatively quiet, but makers are not disposed to enter into commitments for forward delivery at the prices ruling on account of the costs of production.

Sheet Mills Closed.

It is reported at Newport that J. Lysaght, Limited, the well known sheet manufacturers, have closed down their sheet mills at Newcastle, Australia. Some of the workmen propose returning to this country.

LAUNCHES AND TRIAL TRIPS.

NAUSICAA, oil tanker; built by the North of Ireland Shipbuilding Company, Limited; to the order of Compagnie Auxiliaire de Navigation, Paris; dimensions, 388ft., 52ft. 6in., 29ft. 3in.; to carry oil cargo. Engines, triple-expansion type, having cylinders 26in., 43in. and 72in. by 48in., taking steam at 180 lb. from three large boilers, working under forced draught. They burn either oil or coal, and are being built by Messrs. John G. Kincaid and Co., Limited. The vessel and machinery have been designed for a speed of 11 knots on 23ft. mean draught.

MONIQUE, oil tanker; built by the Chantiers et Ateliers de la Gironde, Bordeaux; to the order of the Compagnie Auxiliaire de Navigation, Paris; dimensions, 425ft., 57ft., 33ft.; to carry petroleum cargo. The main engines have cylinders 28in., 46in. and 76in. by 52in. stroke, taking steam at 180 lb. pressure from four large single-ended boilers, arranged for coal or oil fuel burning, having three furnaces in each boiler and working under forced draught. These boilers have been constructed by the shipbuilders. The oil-burning has been installed by the Société Normande, Cherbourg. Trial trip, March 7th, when a speed of 11.2 knots was attained.

ARNUS, twin-screw motor vessel; built by Swan, Hunter and Wigham Richardson, Limited, Neptune Works, Newcastle-on-Tyne; to the order of Cia. General de Tabacos de Filipinas of Spain; dimensions, 377ft., 49ft., 28ft. 9in.; to carry over 6000 tons of oil and general cargo. Engines, twin screws, each driven by a set of "Neptune" marine oil engines of the two-cycle, port-scavenging, long-stroke type, with six working cylinders, each set designed to develop about 1000 brake horse-power. These engines are also being constructed by Swan, Hunter and Wigham Richardson, Limited. The scavenging cylinders are underneath the working cylinders, and are used for starting and reversing the main engines with low-pressure air. Launch, March 14th.

CITY OF YOKOHAMA, geared turbine steamer; built by Wm. Gray and Co. (1918), Limited, West Hartlepool; to the order of the Ellerman Lines, Limited, of Liverpool; dimensions, 484ft. 6in., 58ft. 2in., 34ft. 8in.; to carry cargo. One high-pressure turbine of impulse type and one low-pressure turbine of the reaction type independently connected through flexible couplings to a set of double reduction gear wheels, which drive a four-bladed propeller through a single line of shafting. Constructed by the Central Marine Engine Works of the builders. Steam supplied by four boilers to burn coal or oil. Pressure 225 lb. per square inch. Trial trip, March 9th.

KAULDI steel screw steamer; built by the Blyth Shipbuilding and Dry Docks Company Limited; to the order of Messrs Hijos de Astigarraga, Bilbao, Spain; dimensions, 331ft., 46ft. 8in.; to carry cargo. Engines, triple-expansion, 25in., 41in. and 68in. by 45in. stroke; constructed by Messrs. Geo. Clark, Limited, Sunderland. Trial trip, March 10th.

SOPHOCLES, twin-screw passenger and cargo vessel; built by Harland and Wolff, Limited; to the order of Geo. Thompson and Co., Limited; dimensions, 500ft. by 63ft. by 35ft. 3in.; 12,300 gross tonnage. Engines, Brown-Curtis compound turbines; constructed by the builders; trial trip, February 2nd.

LONDON MARU; built by Cammell Laird and Co., Limited; to the order of the Osaka Shosen Kaisha; dimensions, 450ft. by 56ft. 6in. by 35ft. 3in.; to carry, 10,000 tons. Engines, Parsons turbines, double reduction gear, pressure 200 lb.; constructed by the builders; trial trip, February 8th.

DINTELDYK, twin-screw motor vessel; built by Harland and Wolff, Limited; to the order of the Holland-American Line; dimensions, 502ft. by 62ft. by 38ft. 6in.; to carry 9300 tons. Engines, crosshead type, eight-cylinder, four-cycle Diesel oil; constructed by the builders; delivered to owner, February 10th.

MAID OF HYDRA, single-screw steam cargo vessel; built by John I. Thornycroft and Co., Limited; to the order of Mr. Michael Embiricos; dimensions, 250ft. 6in. by 240ft. by 36ft.; to carry 2000 tons deadweight. Engines, triple-expansion, 18in., 30in. and 50in. by 33in. stroke, pressure 180 lb. per square inch; constructed by the builders; trial trip, Monday, February 13th.

MAID OF PSARA, single-screw steamer; built by Cammell Laird and Co., Limited; to the order of Mr. Michael Embiricos, for the Byron Steamship Company, Limited; dimensions, 374ft. by 50ft. by 25ft.; 10,500 tons displacement. Engines, set of Parsons compound impulse and reaction turbines, pressure 180 lb.; constructed by the builders; launch, February 13th.

SAN GERARDO, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Limited; to the order of Eagle Oil Transport Company, Limited; dimensions, 548ft. by 68ft. 6in. by 42ft. 3in.; to carry 18,000 tons deadweight. Engines, single-screw double-reduction geared turbines, pressure 200 lb.; constructed by the builders; trial trip, Tuesday, February 14th.

CATALOGUES.

HENRY MILNES, Ingleby Lathe Works, Bradford.—Illustrated catalogue of Type R lathe, 3¼in. centre. This treadle screw-cutting lathe has just been placed on the market by Mr. Milnes.

STANTON IRONWORKS COMPANY, Limited, near Nottingham.—Illustrated list of cast iron pipes in stock January, 1922. The company is able to supply the Stanton-Hume reinforced concrete pipe from 4in. to 60in. diameter.

THE WEST KENT WORKS, Limited, agricultural engineers, Westerham.—A leaflet illustrating an automatic tractor tip cart, suitable for farmers and contractors. This cart can be attached to the rear of the tractor and thus does away with a horse.

MICHELL BEARINGS, Limited, South Benwell, Newcastle-on-Tyne.—A new edition of the Michell bearing book is to hand. This edition constitutes a short introduction to the modern science of lubrication, with some illustrations of practical examples embodied therein.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, East Pittsburg, Pa., U.S.A.—Copy of price supplement for general catalogue, dated January 16th, 1922, effective on January 16th, 1922. Supersedes price supplement dated August 15th, 1921. The list consists of over thirty-six pages of alterations.

SAMUEL OSBORN AND CO., Limited, Clyde Steel Works, Sheffield.—Pamphlet No. 2 on Osborn's toughened steel castings and forgings. Illustrations of the different types are included. Also Pamphlet No. 1 on Osborn's "Titan" manganese steel castings and forgings, of which different types are illustrated. Booklet entitled "Carbon Tool Steels—Hints."

ADAMS-HYDRAULICS, Limited.—"Sewerage, Sewage Purification Works, Sewage Lifting, &c." An extremely well got up and illustrated catalogue of the numerous types of machines apparatus and fittings which this firm makes for use in the disposal of sewage. It is divided into seven sections, as follows:—"Automatic Sewage Lifting," "Sewage Ejectors, Centrifugal Pumps, &c.," "Sewage Purification," "Sewer Flushing," "Sewerage Ironwork," "Venturi Tubes and Meters," and "Manhole Covers," and altogether it contains a very large amount of useful information.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	28/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 7 6	—
No. 1 Foundry	5 0 0	—
No. 3 ,,	4 15 0	—
N.E. Coast—		
Hematite Mixed Nos.	5 0 0	5 0 0
No. 1	5 1 0	5 1 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 2 6	4 2 6
Mottled	3 15 0 to 4 0 0	3 15 0 to 4 0 0
White	3 15 0 to 4 0 0	3 15 0 to 4 0 0
Midlands.		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 10 0 to 5 15 0	

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
Scotland—		
Crown Bars	11 10 0	—
Best ,,	12 0 0	—
N.E. Coast—		
Common Bars	12 0 0	—
Tees	14 10 0	—
Lancs.—		
Crown Bars	12 0 0	—
Hoops	14 0	13 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
Midlands—		
Marked Bars (Staffs.)	14 10 0	—
Crown Bars	11 10 0 to 12 0 0	
Nut and Bolt Bars	10 10 0 to 10 15 0	
Gas Tube Strip	12 10 0	—
Hoops (*Nom.*)	14 0 0 to 15 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	14 0 0	—
Ship Plates ¾in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ⅛in. to ⅜in.	11 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	£16 10 0 to 17 0 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 10 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	9 5 0	—
Soft Billets	7 5 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
Manchester (*Prices irregular and uncertain, unchanged*)—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
Sheffield—		
Siemens Acid Billets	10 0 0 to 11 0 0	
Bessemer Billets	12 10 0	—
Hard Basic	9 5 0	—
Soft ,,	7 10 0	—
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
Midlands—		
Small Rolled Bars	9 0 0 to 9 5 0	
Bessemer Billets	7 10 0 to 8 0 0	
Hoops	12 0 0	—
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	12 10 0 to 13 10 0	
Galv. Sheets (f.o.b. L'pool)	16 0 0 to 16 5 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/- to 19/6
Block Tin (cash)	143 7 6
,, (three months)	144 17 6
Copper (cash)	59 2 6
,, (three months)	60 0 0
Spanish Lead (cash)	21 15 0
,, (three months)	21 10 0
Spelter (cash)	25 15 0
,, (three months)	25 17 6
Manchester—	
Copper, Best Selected Ingots	64 10 0
,, Electrolytic	67 0 0
,, Strong Sheets	90 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	22 15 0
,, Foreign	21 10 0

FERRO ALLOYS.

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£26 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£25 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£70	26 -
,, 1 p.c. ,,	£88	30/-
,, 0·75 p.c. carbon	£103	37/-
,, carbon free	2/- per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£25 10 0 scale 6/- per unit	
,, Vanadium	20/- per lb.	
,, Molybdenum	7/- per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£180	
Cobalt	14/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	Export.
Scotland.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	21/-
,, ,, Ell	21/3
,, ,, Splint	22/6 to 25/3
,, ,, Trebles	23/-
,, ,, Doubles	21/6
,, ,, Singles	18 6
Ayrshire—	
(f.o.b. Ports)—Steam	21/-
,, ,, Splint	22/6
,, ,, Trebles	23/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	19/6 to 23/-
Screened Navigation	27/6
Trebles	23/6
Doubles	21/6
Singles	19/-
Lothians—	
(f.o.b. Leith)—Best Steam	21/6
Secondary Steam	20/9
Trebles	23/6
Doubles	21,9
Singles	19/-
England.	
(8) N.W. Coast—	
Steams	33/-
Household	40/- to 55/-
Coke	34/-
Northumberland—	
Best Steams	25/- to 26/-
Second Steams	23/- to 26/6
Steam Smalls	14/- to 15/-
Unscreened	21/6
Household	25/- to 30/-
Durham—	
Best Gas	23/- to 23/6
Second	21/- to 22 -
Household	25/- to 30.-
Foundry Coke	38/- to 40/-
Sheffield— **Inland.**	
S. Yorks. Best Steam Hards	22/- to 23/- —
Derbyshire Hards	21/- to 22/- —
Seconds	20/- to 21/- —
Cobbles	19/- to 20/- —
Nuts	17/- to 18/- —
Washed Smalls	11/- to 12/- —
Best Hard Slacks	12/- to 13/- —
Seconds ,,	10/- to 11/- —
Soft Nutty ,,	9/- to 10.- —
Pea ,,	7/- to 8/- —
Small ,,	4/- to 5/- —
House, Branch	37/- to 39 - —
,, Best Silkstone	34/- to 35/- —
Blast Furnace Coke (Inland and Export)	17/6 to 22 6
(9) South Wales.	
Cardiff— Steam Coals:	
Best Smokeless Large	27/6
Second ,, ,,	27/-
Best Dry Large	26/6 to 27/-
Ordinary Dry Large	24/- to 25/-
Best Black Vein Large	26/6 to 27/-
Western Valley ,,	26/- to 26/6
Best Eastern Valley Large	26/- to 26/6
Ordinary ,, ,,	24/- to 25/-
Best Steam Smalls	18/6 to 19/6
Ordinary ,,	15/- to 18/6
Washed Nuts	27/6 to 32/6
No. 3 Rhondda Large	30/- to 32/6
,, ,, Smalls	19/6 to 20/6
No. 2 ,, Large	23/6 to 24/-
,, ,, Through	20/- to 22/-
,, ,, Smalls	16/- to 18/-
Coke (export)	30/- to 35/-
Patent Fuel	26/- to 28/-
Pitwood (ex ship)	32/6 to 33 -
Swansea— Anthracite Coals:	
Best Large	37/6 to 40/-
Seconds	30/- to 35/-
Red Vein	27/6 to 28/6
Big Vein	37/6 to 40/-
Machine-made Cobbles	50/- to 55/-
Nuts	55/- to 57/6
Beans	50/- to 55/-
Peas	20/- to 22,6
Breaker Duff	9,6 to 10/-
Rubbly Culm	14/- to 15/-
Steam Coals:	
Large	21/- to 24/-
Seconds	20/- to 22/6
Smalls	13/- to 18/-
Cargo Through	18,6 to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b

French Engineering Notes.

(From our Correspondent in Paris.)

Commercial Liberty.

THE federations which group the interests of the whole of the commercial and industrial communities are taking an increasingly active part in the economical reorganisation of the country, and further congresses were held this last week, when certain resolutions were passed which showed plainly that manufacturers, traders and others are not in agreement with the policy so far pursued by the Government. They recognise that matters have gone too far in the way of sacrificing the interests of foreign countries for the protection of industries, and the productive capacity is at present so far in excess of home requirements that the only way of reviving trade is to look to foreign markets, which naturally cannot buy when they are unable to sell goods in return. The federations are therefore very insistent in their demands for a more liberal policy, particularly in the way of removing restrictions upon foreign trade and adapting the import duties to the general interest rather than to the advantage of particular industries. It is now officially stated that restrictions upon exports are to be entirely abolished, and there is plenty of evidence that some concession is to be made to foreign countries in the way of lower import duties, although it is certain that any reduction will be strongly resisted by some of the manufacturing interests. With the operation of the eight hours' day, whereby the production has fallen in proportion to the wages paid, the manufacturing costs are still so high that even countries with appreciated monetary values are offering metallurgical and other goods at prices that would undersell the French if it were not for the import duties.

Naval Constructions.

After undergoing several modifications since its introduction two years ago, the programme of naval construction, providing for an expenditure of 755 million francs to be spread over a period of four years, has been adopted by the Senate. The five battleships of the "Normandie" class, which were started upon before the war and are now hopelessly out of date, are, of course, to be scrapped. The Béarn, which was near completion at the Armistice, is alone to be utilised as a seaplane carrier. The new constructions comprise three light cruisers of 8000 tons, which are to carry eight guns of 150 mm., four of 75 mm., and eighteen torpedo tubes, and to be capable of steaming at 34 knots; six destroyers of 2500 tons with a speed of 35 knots; twelve torpedo boats of 1400 tons with a speed of 32½ knots; and twelve submarines with an immersed displacement of 1100 tons and having a radius of action of 7000 miles. The programme came in for some stringent criticism on the ground that it was a continuance of the policy adopted for so many years past of equipping the navy with a variety of "samples" that prevented the constitution of a homogeneous fleet. It was admittedly a provisional programme, adapted to the present financial conditions, and was intended to "carry over" until such time as a more ambitious scheme of construction could be introduced, for the general tendency of the debate was in favour of France possessing an adequate defensive navy which could not be sacrificed even if the security of the country were guaranteed by other naval Powers. The idea of constructing capital ships up to the tonnage allowed by the Washington Conference seems, for the moment, to have been abandoned. No one suggested their necessity or even their utility, and it is noticeable that French naval strategy is centred entirely in the light and fast cruisers, destroyers, submarines, and air craft. The Minister of Marine affirmed that the future programme would provide for a complete organisation of aeroplanes in association with a large number of submarines, and it was evident from the debate that no concession is likely to be made to other Powers in the number of submarines that may be constructed, for vessels of that type are regarded as indispensable for the security of the country and for maintaining a seaway between France and North Africa.

The Dordogne Barrage.

The Dordogne, which takes its rise in the Auvergne mountains and joins the estuary of the Gironde, is a rapid river totally unfit for inland navigation, but providing a reserve of energy which has received special attention since the importance of hydro-electric distribution was impressed upon the country at a time when the prices of imported fuels rose to an abnormal level. The late M. Claveille, former Minister of Public Works, was largely responsible for the interest aroused in the possibilities of the Dordogne, and a scheme has now been prepared for constructing four barrages and generating stations between the towns of Vernéjoux and Brivesac, capable of supplying 86,000 kilowatts. The cost is estimated at 400 million francs. The first barrage to be constructed will have a height, including the foundation, of 114 m., which will, it is said, make it the highest in the world. Its construction alone will cost 100 million francs and a million cubic metres of masonry will be employed. It will hold back 715 million cubic metres of water, creating an artificial lake 2650 acres in extent.

A National Fuel.

A commission has been appointed by the Government to draw up a programme for the production of benzol in France and the Colonies. This is in pursuance of the policy carried out for some time past in favour of creating a "national fuel," that is to say, the production of power alcohol and benzol in sufficient quantities to supply the whole of the home needs. At present France does not produce more than 800 tons of benzol a month, and Germany supplies to this country about 2000 tons a month, which is largely used as a motor fuel by mixing it in equal proportions with petrol. The forthcoming congress on a "national fuel" at Béziers is intended to give a further stimulus to the employment of alcohol for power purposes, and for more than a year past the Government has had in hand a Bill to authorise it to control the production and sale of alcohol.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

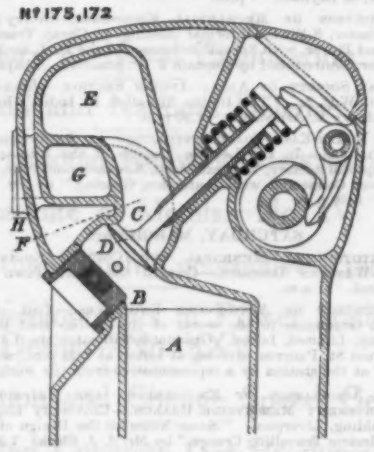
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

175,172. January 14th, 1921.—CYLINDER HEADS, H. Marchand', 11, Raphael-street, London, S.W.

THE inventor claims that his design of cylinder head offers special facilities for manufacture combined with efficient working. The arrangement of the various parts can be followed in the drawing, in which A is the engine cylinder, B is the combustion chamber, C is the exhaust port, D are the inlet and

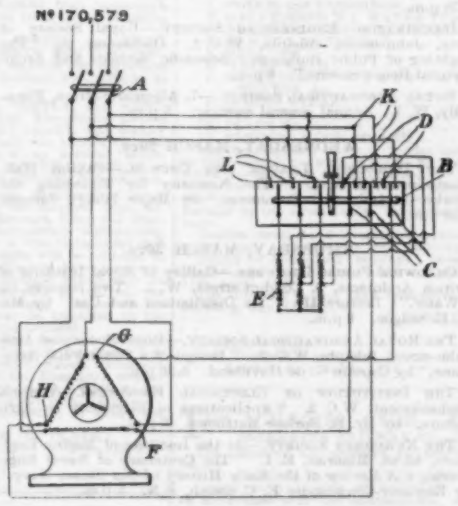


exhaust valves, E is the main exhaust manifold, F is the inlet port, G is the main inlet manifold and H is the main induction pipe. The inlet valve is not visible, it lying parallel with and immediately behind the exhaust valve. The inlet and exhaust valves D are both inclined, as shown, at an angle of 45 deg. to the vertical.—*February 16th*, 1922.

DYNAMOS AND MOTORS.

170,579. October 17th, 1921.—IMPROVEMENTS RELATING TO STARTING DEVICES FOR THREE-PHASE SHORT-CIRCUITED MOTORS, Bergmann-Elektricitäts-Werke Aktiengesellschaft, of 64–67, Seestrasse, Berlin, N. 65, Germany.

According to this invention, a star delta switch operates in conjunction with an auxiliary transformer in order to adjust the terminal voltage at starting. After closing the main switch A, the change-over switch B is manipulated, so that the contact arms C engage with the contacts D. In this position of the switch, the auto-transformer is connected up to the contacts L, whilst the terminals F G H of the stator winding of the motor

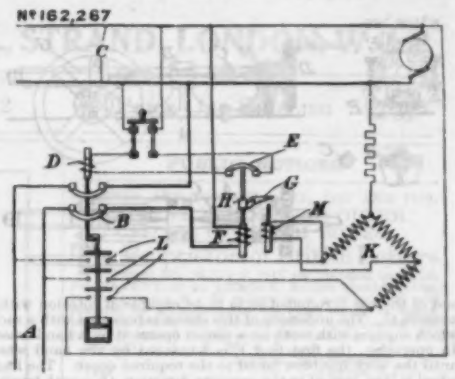


are connected to the centre points of the transformer phases. The stator winding is thus star connected, and part of the auto-transformer is in series with the motor windings. When the motor has been started the switch B is moved to its second position, when the contact arms C engage with the fixed contacts connected to the leads K. The motor is then connected in mesh and the auto-transformer is cut out of circuit by the three left-hand switch arms leaving the contacts L. The transformer is provided with tappings, and the effective starting voltage is adjusted according to requirements.—*February 16th*, 1922.

SWITCHGEAR.

162,267. February 16th, 1922.—IMPROVEMENTS IN ELECTRICAL CIRCUIT INTERRUPTERS, Metropolitan-Vickers Electrical Company, Limited, of 4, Central-buildings, Westminster.

This invention relates to a circuit breaker which opens on short circuit or overload, and closes again automatically when the short circuit has cleared itself. A circuit A receives energy through a circuit breaker B from bus-bars C, which are energised with direct current. The circuit breaker is provided with a closing coil D, which may be energised directly from the bus-bars through a switch. The auxiliary switch E is actuated by a trip magnet F, and opens the circuit of the closing winding D, when an excessive current traverses the circuit breaker B. When the auxiliary switch E is actuated by the coil F, a latching member G engages with a cam H, which is mounted on a rod of the auxiliary switch E, so as to maintain the switch E in the open position. When the circuit breaker B is open, a Wheatstone bridge K is energised by means of the contacts L,

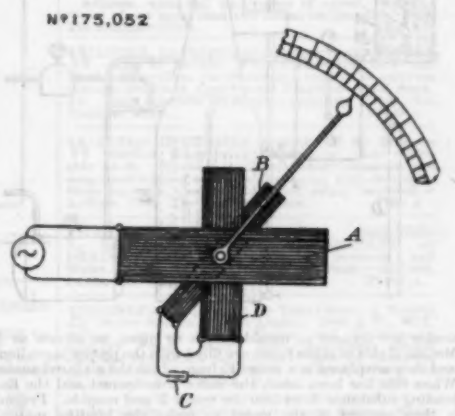


and when the resistance of the circuit increases as a result of a removal of the short circuit, a fourth arm of the bridge, which consists of a coil M, resets the auxiliary switch E by actuating the latch member G and releasing the cam member H, with the result that the coil D is energised and the switch B closes.—*February 26th*, 1922.

TESTING AND MEASURING INSTRUMENTS.

175,052. November 8th, 1920.—IMPROVEMENTS IN AND RELATING TO ELECTRIC INDICATING AND MEASURING INSTRUMENTS, The British Thomson-Houston Company, Limited, of 83, Cannon-street, and Reginald Charles Clinker, of "The Rowans," Inwoods, near Rugby.

This invention relates to an instrument for measuring frequency. A represents a fixed coil, which is connected to the alternator, the frequency of which it is desired to measure. Between the inner sides of this coil, a second coil B is pivoted, and this coil carries a pointer. The circuit of this coil is closed through a condenser C. There is also a second stationary coil D

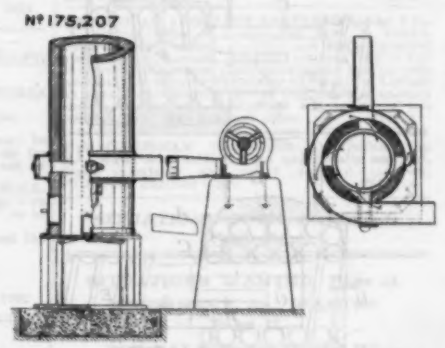


which is at right angles to the coil A. This coil D can either be connected in series with the coil B or may be short-circuited. The moving coil tends to take up a position at right angles to the coil A, but as it turns it is repelled by the fixed coil D, and it takes up a position between the coils A and D, where the effects of these coils are balanced, this position depending upon the frequency of the current in the coil A. The instrument may also be used for measuring inductance or capacity.—*February 8th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

175,207. May 18th, 1921.—CUPOLAS, C. E. Taylor, 5, Central-avenue, Levenshulme, Manchester.

According to the invention, the cupola is built in the usual or other convenient manner, with an exterior shell of boiler plates riveted together and lined with fire-brick. A series of tangentially arranged tuyeres is formed in the wall of the

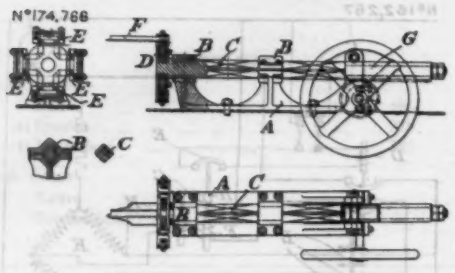


furnace at the correct height, and is surrounded by a casing which is rectangular in cross section, and is formed by a channel-shaped plate of circular shape in plan attached to the shell of the cupola and excentrically relatively thereto, so as to produce a wind belt of gradually decreasing rectangular area from the inlet to the last tuyere, the tuyeres being inclined in the same general direction as the incoming blast.—*February 16th*, 1922.

174,766. November 6th, 1920.—IMPROVEMENTS RELATING TO LATHES, Bullers, Limited, and Gilbert Harvey Harris, both of 6, Laurence Pountney-hill, E.C. 4.

A is the frame of a turning or boring attachment, provided with bearings B, which are square in cross section, as shown on

the left. Slidably mounted in the bearings B is a square bar C, having rounded portions, which when the bar is in the position shown coincide with the bearings and allow the bar C to turn. Fastened to one end of the bar is a plate D, which carries four tool holders E for carrying tools, as shown, for example, at F, and the radial position of these tools can be adjusted. The other

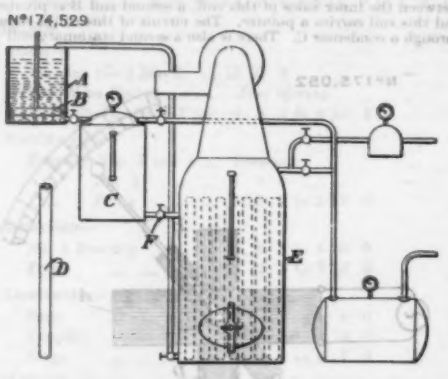


end of the bar is rounded so as to be capable of rotation within a sleeve G. The underside of this sleeve is provided with a rack, which engages with teeth on a pinion operated by a hand wheel. In operation, the first tool F is advanced by the hand wheel until the work has been bored to the required depth. The hand wheel is then turned in the opposite direction, thus withdrawing the tool until the circular portions of the bar C lie within the bearings B. The bar C is then rotated until the next tool holder E with its tool is in position, and the bar advanced again to the work by the hand wheel, and so on.—*February 6th*, 1922.

MISCELLANEOUS.

174,529. February 2nd, 1922.—Improvements in Processes and Apparatus for Making Electrodes and Abrasives, William George Michael, of 1350, Michigan-avenue, Niagara, U.S.A.

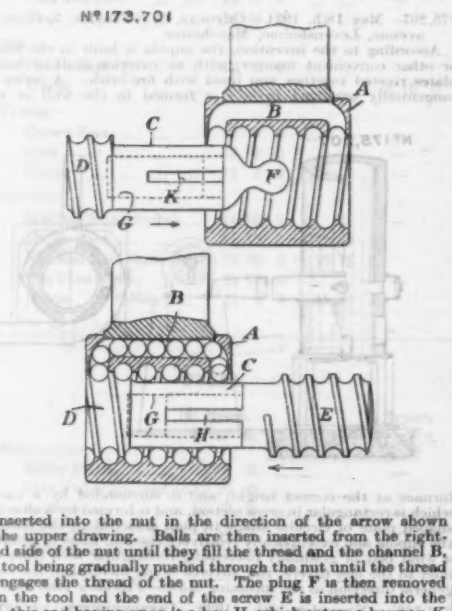
The binding materials used for making the electrodes are placed in a tank A, which is provided with an agitator B. The binding material may consist of tar, pitch, oil or shellac. The tank is heated by steam, and the materials are mixed by the mechanically operated agitator. The fluid so obtained is drained off into the reservoir C, which is also steam heated. The elec-



trodes are formed in moulds, such as pipes, as shown at D. Moulds of this or other forms are filled with the proper ingredients and they are placed in a vessel E, from which the air is exhausted. When this has been done, the valve F is opened and the fluid binding substance flows into the vessel E and moulds. Pressure is then applied to the vessel to make the binding material thoroughly impregnate the electrodes.—*February 2nd*, 1922.

173,701. January 19th, 1921.—Improved Method of and Means for Assembling the Balls in a Bearing Nut, Sir W. G. Armstrong, Whitworth and Co., Limited, and Charles Joseph Wolseley, both of Elswick Works, Newcastle-on-Tyne.

A is a nut having a channel B connecting the two ends of the thread. C is a cylindrical tool having at one end a thread D similar to the thread of the screw E, which is to work in the nut. The tool is hollow and is closed at the commencement of operations by a plug F which fits into a hole G in the tool. The tool



is inserted into the nut in the direction of the arrow shown in the upper drawing. Balls are then inserted from the right-hand side of the nut until they fill the thread and the channel B, the tool being gradually pushed through the nut until the thread D engages the thread of the nut. The plug F is then removed from the tool and the end of the screw E is inserted into the tool, this end having upon it a key H, which enters a keyway K in the tool. The screw is then screwed into the nut so that the tool is moved out of the nut in the direction of the arrow shown in the lower drawing. When the thread of the screw E has passed right through the nut the tool is removed from the end of the screw.—*January 12th*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Production Engineers.—Institution of Mechanical Engineers, Storey's-gate, S.W. Paper, "Inspection Methods," by Mr. E. Fairbrother. 7.30 p.m.

Junior Institution of Engineers.—Caxton Hall, S.W. 1. Question and General Discussion Meeting. 8 p.m.

Institution of Municipal and County Engineers.—Irish District meeting. Library of the Institution of Civil Engineers of Ireland, 35, Dawson-street, Dublin. 2.30 p.m.

Manchester Association of Engineers.—Memorial Hall, Albert-square, Manchester. Annual general meeting. Election of members and officers. "Commercial Motors," by Mr. J. G. P. Thomas, of Leyland. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Informal meeting. "Cheap Transport: Heat and Power, with Special Reference to the D. J. Smith Gas Producer," introduced by Captain P. P. Stanford. Adjourned.

Royal Society of Arts: Indian Section.—John-street, Adelphi, W.C. 2. "The Indigo Situation in India," by Professor Henry E. Armstrong. 4.30 p.m.

The North-East Coast Institution of Engineers and Shipbuilders.—In the Lecture Theatre of the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. "On a Subject Connected with Reduction Gearing," by Dr. J. H. Smith. 6.30 p.m.

SATURDAY, MARCH 25TH.

Institution of Municipal and County Engineers: North-Western District.—Council Chamber, Town Hall, Blackpool. 11 a.m.

Institution of Automobile Engineers.—Visit of the London Graduates to the works of the Skefko Ball Bearing Company, Limited, Luton. Graduates will catch the 1.40 p.m. train from St. Pancras, arriving at Luton at 2.25 p.m., and will be met at the station by a representative from the works.

The Association of Engineering and Shipbuilding Draughtsmen: Merseyside Branch.—University Engineering Building, Liverpool. "Some Notes on the Design of Overhead Electric Travelling Cranes," by Mr. J. J. Clark. 7.30 p.m.

The Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. "Radio-activity," Lecture IV., by Sir Ernest Rutherford, F.R.S. 3 p.m.

TUESDAY, MARCH 28TH.

The Engineers' Club.—Manchester. Annual general meeting. 1.45 p.m.

Institution of Automobile Engineers: Coventry Graduates.—At the Broadway Café, Coventry. Paper, "Road Transport Tires," by Mr. G. M. Martineau. 7.45 p.m.

The Institution of Electrical Engineers.—At the Metropole, Leeds. "Protective Apparatus for Turbo-alternators," by Mr. J. A. Kuyser. 7 p.m. Dinner at 6 p.m.

The Institution of Electrical Engineers.—The College, Loughborough. "The Future Aspect of Power Generation," by Mr. A. H. Seabrook. 6.45 p.m.

The Junior Institution of Engineers: North-Eastern Section.—Armstrong College, Newcastle-on-Tyne. "The Utilisation of Waste Heat," by Mr. G. H. Martin. 7 p.m.

The Institute of Marine Engineers.—85/88, Minories, E. 1. "Petroleum and Lubrication," by Mr. E. A. Evans. 6.30 p.m.

Illuminating Engineering Society.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Discussion on "The Lighting of Public Buildings: Scientific Methods and Architectural Requirements." 8 p.m.

Royal Aeronautical Society.—7, Albemarle-street, Piccadilly, W. 1. Annual general meeting. 5 p.m.

WEDNESDAY, MARCH 29TH.

The Industrial League and Council.—Caxton Hall, Westminster, S.W. 1. "The Necessity for Educating the Worker in Industrial Economics," by Major Isidore Salmon. 7.30 p.m.

THURSDAY, MARCH 30TH.

Chadwick Public Lectures.—Gallery of Royal Institute of British Architects, 9, Conduit street, W. 1. Two lectures on "Water." Lecture II.: "Its Distribution and Use," by Mr. H. E. Stilgoe. 8 p.m.

The Royal Aeronautical Society.—Royal Society of Arts, John-street, Adelphi, W.C. 2. "Design of a Commercial Aeroplane," by Captain G. de Havilland. 5.30 p.m.

The Institution of Electrical Engineers.—Victoria Embankment, W.C. 2. "Applications of Electricity to Agriculture," by Mr. R. Borlase Matthews. 6 p.m.

The Newcomen Society.—At the Institute of Marine Engineers, 85/88, Minories, E. 1. "The Centenary of Naval Engineering: A Review of the Early History of Our Steam Navy," by Engineer-Commander E. C. Smith, R.N. 5 p.m.

FRIDAY, MARCH 31ST.

Junior Institution of Engineers.—Caxton Hall, Westminster, S.W. 1. "The Steel Melting Shop," by Mr. D. P. Dickinson. 8 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Extra general meeting. "The Milling of Screws, and other Problems in the Theory of Screw Threads," by Dr. H. H. Jeffcott. 6 p.m.

The Institution of Electrical Engineers: London Students' Section.—Victoria Embankment, W.C. 2. Address by the President (Mr. J. S. Highfield). 7 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Paper, "Internal Combustion Engines," by Mr. J. Robson. 7.30 p.m.

SATURDAY, APRIL 1ST.

Institution of Municipal and County Engineers.—West Midland District meeting at the Shire Hall, Worcester. 2.45 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. "Radioactivity." Lecture V. By Sir Ernest Rutherford. 3 p.m.

Institution of British Foundrymen: Lancashire Branch.—College of Technology, Manchester. "Plaster Patterns," by Mr. C. Heggie. 4 p.m.

WEDNESDAY, APRIL 5TH.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. "Sea Encroachment and its Prevention," by Mr. Ernest R. Matthews. 8 p.m.

FRIDAY, APRIL 7TH.

Diesel Engine Users' Association.—At the Institution of Electrical Engineers. "Some Characteristics of Petroleum Oil Used in Diesel Engines," by Mr. Harold Moore.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Evolution of the Elements," by Sir Ernest Rutherford. 9 p.m.

Junior Institution of Engineers.—Caxton Hall, S.W. 1. Lecturette, "Engineering in Southern Persia," by Mr. J. W. Maple. 8 p.m.

TUESDAY, APRIL 11TH, TO THURSDAY, APRIL 27TH.

Building Trades' Exhibition.—Olympia.

WEDNESDAY, APRIL 26TH.

Society of Glass Technology.—Royal Victoria Station Hotel, Great Central Railway, Sheffield. Fourth annual dinner, 7 p.m. for 7.15 p.m.

WEDNESDAY, MAY 3RD.

Institute of Metals.—Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual May lecture: "The Relation of the Elements," by Sir Ernest Rutherford. 8 p.m.

THURSDAY AND FRIDAY, MAY 4TH AND 5TH.

Iron and Steel Institute.—Institution of Civil Engineers, Great George-street, S.W. 1. Annual meeting. Annual dinner, Thursday, May 4th, at Connaught Rooms, Great Queen-street, W.C.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We are informed that Major H. O. Wraith, M.I. Mech. E., M.I.E.E., has been appointed manager of the lighthouse department of Chance Brothers and Co., Limited, Smethwick, Birmingham.

Electric Control, Limited, announces that after April 1st, 1922, its London office address will be Hastings House, Norfolk-street, Strand, W.C. 2. Telephone, City 2487; telegrams, "Elecontrol, Estrand, London."

We are asked to state that Mr. W. N. Turner has been appointed London and Birmingham representative of Centrifugal Castings, Limited, of Kirkstyle-road, Kilmarnock. It is requested that communications should be addressed to him at 9, Shaa-road, Acton, London, W. 3.

We are asked to state that Mr. E. M. Griffiths has resigned his position as a director of the Birmingham Small Arms Company, Limited, and also that of chairman and director of Burton, Griffiths and Co., Ltd., one of the associated companies. He is retaining his office at 30-32, Ludgate-hill, London, E.C. 4.

Mr. W. T. Kerr asks us to state that after to-morrow he will no longer be connected with the City of Hereford electricity department, and that for the next few weeks his address will be "Netherwood," Tupsley, Hereford, to which address he requests that all communications regarding the West Gloucestershire power scheme should be addressed.

The Premier Electric Welding Company, Limited, has changed its head office, technical and research laboratories and electrode factory from Bank Buildings, St. James's-street, London, S.W. 1, to Abbey Wood, London, S.E. 2. New telegraphic address, "Premelwel, Abwood, London," and new telephone No., Woolwich 866 (direct London exchange).

The Spearing Boiler Company, Limited, and Tinkers, Limited, of Daisyfield Boiler Works, Hyde, near Manchester, have come to an arrangement under which the former firm acquires the controlling interest in Messrs. Tinkers' business. The Spearing water-tube boiler will in future be made at Messrs. Tinkers' works, where it is proposed to carry out large extensions to cope with the rapidly growing demand for the Spearing boiler. Mr. Spearing will join the board of Tinkers, Limited, as chairman, and Mr. Frank Tinker will continue to act as managing director.

Contracts.—The contract for the signalling materials for the Otira-Arthur's Pass Section of the New Zealand Government Railways has been awarded to the Westinghouse Brake and Saxby Signal Company, Limited, 82, York-road, N. 1. The material will provide for two alternating-current all-electric interlockings, with alternating-current point machines and three-position alternating-current upper quadrant signals. Alternating-current track circuits will be installed. The point control system will be the contractor's type F, with constant indication and track looking of point levers.

The British Cast Iron Research Association.—The Director of Research in his monthly report states that during the month of February a further number of problems of varied character were submitted for investigation and research. Most of them were of general interest and importance. It was again noticeable that the troubles incidental to shrinkage and uneven contraction were widespread in both the grey iron and malleable branches of the foundry industry. Help was sought in the manufacture of ingot moulds, annealing pots, and of castings subject to vibration and coincident fluctuations of heat. Members received assistance in the following problems:—The design of cupola linings and ladles; the influence of de-oxidisers in metal for light castings subject to repeated heatings; the overcoming of erosion defects in centrifugal pump casings and impellers; suitable mixtures for bearings to carry hot running shafts; the function of moisture in cupola coke; mixtures and treatment suitable for malleable castings to carry superheated steam of high pressure.

Institution of Civil Engineers: Students' Dinner.—The forty-first annual dinner of the Students of the Institution of Civil Engineers was held at the Trocadero Restaurant on Friday evening last, the 17th inst., and was successful in every way. The guest of the evening was Mr. W. B. Worthington, President of the Institution, and the chair was ably occupied by Mr. H. C. L. Humphreys, the vice-chairman of the London Students' Committee. Among other prominent members of the Institution present were Sir Maurice Fitzmaurice (past-president), Mr. Basil Mott, and Dr. Jeffcott (the new secretary). In a few well-chosen words, Mr. Worthington encouraged the students in their efforts to promote the welfare of the Institution, and reminded them of the value of reading papers describing from personal observation no matter how small a work, as the discussion of such papers enabled men in parallel walks of the profession to exchange views and to broaden their experience. Dr. Jeffcott, in tracing the growth of the Student Section, stated that although the ranks of the Students had been severely depleted by the war, in the last two years their number had nearly doubled. Mr. H. C. L. Humphreys, the chairman, spoke of the work of the London Committee and its efforts to obtain a wider scope for the activities of the Student Section. He paid high tribute to the sympathetic co-operation of Mr. Basil Mott, who had been deputed by the Council to advise the London Committee in its deliberations and work.